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OPERATING INSTRUCTIONS

MODEL TTS 39 REFERENCE TONE GENERATOR AND ACCESSORIES

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MODEL TTS 39 REFERENCE TONE GENERATOR AND ACCESSORIES

OPERATING INSTRUCTIONS

1.0 GENERAL DESCRIPTION

1.01 The Model TTS 39 consists of a basic unit which includes a transistorized oscillator delivering a constant output level. Space is available on the panel to supply up to four independent output modules, designated as Model TTS 39XB; these can be connected for either 600 or 900 ohms output impedance. Each module contains a transistorized amplifier, a DC blocked balanced output transformer, a coarse and fine output level control to permit adjusting the output level between -1 dbm and +2 dbm, a monitoring jack, and space for mounting a hold coil, a gas tube, a relay which may be used as a start relay for starting special functions, a relay for ON HOOK-OFF HOOK cycling, and a transfer relay for special applications. The output stages are completely independent of one another; trouble in one output has no effect on the other outputs. No damage will result if ringing voltage is applied to an output.

1.02 Two versions of the Model TTS 39 are available:

1. The Model TTS 39A includes the basic milliwatt generator and provisions for mounting four output stages.

2. The Model TTS 39B is the same as the Model TTS 39A, but is also equipped with a cycling adapter which provides a ground contact at regular time intervals, such as once in every 10 seconds. This model is used when ON HOOK-OFF HOOK cycling is required for the Model TTS 39XB output modules or when it is desired to provide interruptions in the output signal.

1.03 If more than four output stages are needed, the Model TTS 39D Distribution Amplifier panel is available to mount up to four additional output modules per panel. By adding more TTS 39D panels a large number of independent output stages can be provided.

1.04 The TTS 39 may also be used in combination with the Model TTS 39XF Frequency Cycling Adapter to supply a milliwatt signal at up to ten frequencies which can be automatically cycled in sequence at predetermined time intervals. Unless additional frequencies are ordered, three frequencies are normally supplied in the TTS 39XF. If additional frequencies are needed after a unit has been installed, components may be added in the field to include the desired frequencies in the cycling sequence. Any frequency between 300 and 10,000 cps may be used; each output stage is designed to accommodate the full range of frequencies without affecting the output level set for one frequency. Frequencies may be arranged in any sequence, and the time interval for each frequency may be set between 5 and 15 seconds. It may be desirable to use 1000 cps as the first frequency in the cycling sequence and to provide a longer time interval for it than for other frequencies; this will facilitate identifying the start of another sequence of frequencies.

1.05 Both models can accommodate up to four TTS 39XB Output Amplifier Modules, each of which can provide an output impedance of 600 or 900 ohms. The output impedance is selected by installing the proper straps. Resetting of the output level is necessary when the output is changed from one impedance value to another. The level in each output circuit is independent of the load applied to the other circuit. The output of each circuit is normally 0 dbm, but both coarse and fine adjustments are provided in each channel to permit setting the output level to any desired value from -1.0 dbm to +2.0 dbm.

1.06 Each TTS 39XB Output Amplifier Module is provided with a TEST jack to monitor the output level. The insertion of a test cord in these jacks disconnects the output from the connector appearance.

1.07 The TTS 39 group of equipment may be supplied in a TCC 39 portable carrying case.

1.08 The TTS 39 group of equipment is designed to operate from a well filtered 48 volt DC source.

2.0 TRANSMISSION PERFORMANCE

2.01 Because of the basic temperature sensitivity of semiconductors the following specifications are intentionally conservative. Representative sets show substantially better performance than that specified. In most installations the temperature variations are relatively small; consequently, the variations in performance are very small.

2.02 Specifications

Frequency Tolerance: ±1%

Output Frequencies

Single Frequency Operation	1000 cps. Other frequencies between 300 and 10,000 cps can be supplied.	Harmonic Distortion: 50° to 110°F ≦1%
Multifrequency Operation when TTS 39XF is used	Up to 10 frequencies; any group between 300 and 10,000 cps can be supplied. It is suggested that 1000 cps be the first frequency in the sequence.	Output Level: Nominal 0 dbm, Maximum +2.0 dbm, Minimum -1.0 dbm Output Level Variations: Temperature: 50° to 110°F ≦0.10 db
Frequency Switching Time when TTS 39XF is used	Can be supplied to operate at time intervals ranging from 5 seconds to 15 seconds for each frequency	At a given temperature level is held to better than 0.05 db. Voltage: 42 to 50 volts ≦0.05 db Supply: 48 volts DC will operate between 44 and 54 volts

Current Drain

TTS 39A or B with four TTS 39XB's	MAX 500 MA
when used with TTS 39XF	MAX 950 MA

Size

TTS 39A or B	5¼" x 19"
TTS 39XF	3½" x 19"
TTS 39D	5¼" x 19"

3.0 CIRCUIT DESCRIPTION

Basic Panel

3.01 The schematic diagram to which the following description applies is shown in Fig. 1. A component placement diagram is shown in Fig. 1A.

3.02 The TTS 39A or B is a basic panel containing the terminals, wiring, oscillator, and associated circuitry necessary to accommodate up to four TTS 39XB Output Amplifier Modules. Terminals are also provided for the convenient addition of the TTS 39XF Frequency Cycling Adapter and for the Model TTS 39D Distribution Amplifier Panels.

3.03 Common fusing, power switching, and reverse voltage protection for the Models TTS 39 and TTS 39XF are supplied by fuse F1, power switch S1, and diode CR1. A power on indication is supplied by pilot lamp PL1.

3.04 Voltage division for the level stabilizing oven unit is supplied by resistor R31. Capacitor C1 provides spark suppression for the thermostat switching contacts located with the oven unit. The DC voltage at pin 3 of the oven should read 24 volts when heating.

3.05 Decoupling between the battery supply and the tone generator is supplied by resistor R35 and capacitor C2. Resistors R32 and R34 and capacitor C3 provide voltage division and filtering for the oscillator amplifier unit.

3.06 The OSC TEST jack provides access to the output of the oscillator amplifier unit.

CAUTION: Damage to the thermistor within the oven unit may result should voltage be applied to the OSC TEST jack.

3.07 DC blocking between the output of the oscillator amplifier unit and external TTS 39D Distribution Amplifier Panels is provided by capacitor C4. This circuit is extended to terminal 12 of terminal board TB1.

3.08 Terminals A through G of terminal board TB1 provide the internal connections to the Model TTS 39XB Output Amplifier Modules. These connections include battery, ground, signal input, and control circuits.

3.09 Terminals 3 through 11 are for the addition of a Model TTS 39XF Frequency Cycling Adapter Unit.

Oscillator Amplifier Circuit

3.10 The circuit diagram to which the following description applies is shown in Fig. 2. A component placement diagram is shown in Fig. 2A.

3.11 A bridged-T type of R-C oscillator, consisting of three transistor stages, is used. The first two transistors are directly coupled from the collector of Q1 to the base of Q2. The positive feedback path is completed from the emitter of Q2 back through a blocking condenser and a tungsten lamp, utilized for level stabilization, to the emitter of Q1. A part of the emitter resistance of Q1 has been made variable to allow setting the correct amount of positive feedback necessary for stable operation.

3.12 A negative feedback which is greater than the positive feedback is supplied to the base of Q1 through a null selective network and an emitter follower. At its tuned frequency the selective bridged-T null network decreases the negative feedback sufficiently to permit oscillation to occur at the desired frequency, which is determined by the R-C values employed within the network. This frequency determining network consists of two padded capacitances and two selected resistors.

3.13 Amplifier stage Q4 and the cascaded emitter follower stages Q5 and Q6 provide the necessary voltage and current gain required to drive the thermistor Tx, located within the special temperature oven, onto its voltage maximum or "hump." The output level of the amplifier stage driving the thermistor is determined by the setting of potentiometer R19. Capacitor C7 provides the DC blocking between the output emitter follower Q6 and the thermistor.

Output Amplifier Circuit

3.14 The Model TTS 39XB Output Amplifier Module consists of a highly stabilized buffer amplifier, a cascaded emitter follower stage, and a ringing voltage protection network mounted individually within a protective enclosure. These units can be arranged in the field for either 600 or 900 ohm operation. Output levels are adjustable over a range from -1 dbm to +2 dbm. The circuit diagram to which the following description applies is shown in Fig. 3. A component diagram is shown in Fig. 3A.

3.15 The input from the common oscillator unit is coupled to the Q1 buffer amplifier stage through potentiometers R3 and R17. These controls provide the COARSE and FINE adjustment of the output level. Capacitor C1 provides DC blocking for the base circuit of transistor Q1. The output of the Q1 buffer amplifier stage appears across the collector load resistor R6 and in turn is coupled to the cascaded emitter follower stage through blocking capacitor C2. The signal voltage appearing across the R10 emitter load resistor of transistor Q3 is coupled to output transformer T1 through DC blocking capacitor

C3. Precision resistors R12 and R13 provide the impedance buildout for either 600 or 900 ohm operation. The 600 ohm condition exists when resistor R13 is strapped out of the circuit over terminals marked Z. The non-polarized, electrolytic capacitor C4 provides DC blocking for the output circuit. Diodes CR1 and CR2 and resistor R11 constitute the ringing voltage protection network.

3.16 The output of transformer T1 is coupled to terminals 1 and 2 of the terminal board located on the rear of the module. This circuit is carried over contacts of the test jack. When plugged into the test jack all external circuits are disconnected by the interrupter springs of the test jack.

3.17 Resistors R14 and R15 and capacitor C5 provide voltage division and filtering for the output amplifier circuit. Resistor R16 serves as the sleeve resistance to battery for the external circuit connected to the module.

Time Cycle Generator

3.18 The Model TTS 39B also contains a time cycle generator as standard equipment. This unit provides the time base for the cycling ON and OFF HOOK supervision when used in conjunction with one or more output amplifier modules equipped with Option 3. Start ground for the time cycle generator is derived through an isolating diode from the sleeve circuit of the output amplifier modules equipped with Option 3. The above diode is a part of Option 3.

3.19 A schematic diagram of the time cycle generator circuit is shown in Fig. 4. A component placement diagram is shown in Fig. 4A. The operation of the time cycle generator is as follows:

3.20 When ground is applied to start lead S of the generator circuit, capacitor C1 in the base circuit of transistor Q1 will charge over the break contacts of relay K2 and resistor R6 to the regulated voltage appearing at the junction of R1 and zener diode CR2. Relay K1, which is in the emitter circuit of Q1, will operate when the base voltage of Q1 has risen to approximately 8 volts. The selected value of R6 determines the rise time and is selected to produce a time constant of 1 second. Relay K1, when operated, interrupts the ground circuit to terminal G over its make contacts 4 and 5. Terminal G is part of TB1 of the basic panel shown in Fig. 1.

3.21 K1, operated, also energizes relay K2. Relay K2, when operated, interrupts the charging circuit from battery via R6 to C1 and establishes a circuit from ground through R5, its make contacts 3 and 4 to capacitor C1, which will slowly discharge capacitor C1. The time required to discharge C1 is determined by the selected value of R5. R5 has been selected to provide a discharging time constant of 10 seconds. After C1 has discharged sufficiently to allow K1 to release, ground is again applied to terminal G and the charging circuit for C1 re-established.

3.22 The above operation is repetitive and will continue as long as ground appears on the start lead. Diode CR1 provides reverse voltage protection for the circuitry should battery inadvertently be connected in reverse. Resistors R2 and R3 serve as a voltage divider to supply the proper collector voltage to transistor Q1.

TTS 39XF Frequency Cycling Adapter

3.23 The Model TTS 39XF unit contains the time base and the switching to provide the cycling of up to 10 frequencies in sequence. The start ground for the TTS 39XF is derived from the Option 4 circuitry associated with the Output Amplifier Modules assigned for multifrequency operation. A schematic diagram of this unit is shown in Fig. 5. A component placement diagram is shown in Fig. 5A. The operation of this unit is as follows:

3.24 Ground, when applied to either of the start leads, will operate the START and HOME relay SH. These start leads are brought out to terminals 3 and 4 of terminal board TB1. Two separate start circuits are employed to allow "X" number of frequencies to be supplied by one Output Amplifier Module and "Y" number by the second, i.e., 3 frequencies for the #1 and 10 frequencies for the #2 module. The number of frequencies is determined by the strapping on wiper banks E and F of selector switch RM.

3.25 START and HOME relay SH, when operated, applies battery to the delay follow relay DF, removes ground from the homing circuit of RM, and applies ground to the C wiper of RM. Ground, when applied to the C wiper of RM, will move RM from the home to its first position. The coil circuit of DF is completed by the operation of SH, from battery, the coil of DF, break contacts 2 and 3 of delay relay D to ground through capacitor C1. As the charging current for C1 must pass through the coil of DF, DF will operate momentarily until the voltage appearing across C1 has reached the operating point of relay D. D will then energize, thus interrupting the coil circuit of DF, causing it to release. Relay DF, while operated, supplies a step pulse to RM, causing it to move one step. The next step pulse for RM will be applied upon the release of relay D, which will again operate DF momentarily. This operation is repetitive until the start ground has been removed.

3.26 The C wiper circuit of RM is employed to cause RM, when reaching its home position, to advance to its first position. This circuit prevents the first frequency within the sequence to be transmitted twice for each revolution of RM. Normally, as shown in the schematic, the frequency that is associated with the first position of RM is also associated with the home position (this frequency switching is accomplished over banks A and B of RM). When the TTS 39XF is associated with TTS 39 units employing both multi and single frequency operation, the output modules associated with the single frequency operation will not supply a start ground to the TTS 39XF unit. Thus it can be seen that the frequency transmitted for single

frequency operation will be that of the first frequency transmitted in the multifrequency operation. However, in multifrequency operation, this will only be transmitted for one interval during each revolution of RM, as RM cannot stop in its home position for reasons explained above.

3.27 The function of the D bank of RM is to provide switching to change the time intervals of the frequencies to be transmitted. These time intervals are normally arranged so that approximately 10 seconds will be allowed for the first frequency and approximately 5 seconds for the remaining frequencies. However, other time intervals can be supplied through the selection of the proper value of R101.

3.28 Pilot lamp PL1 is controlled by the ONC and RM contacts of RM. When RM is in the home position, the ONC contacts complete a circuit from ground to PL1, causing it to light. When not in the home position, PL1 will flash upon the operation of the RM contacts associated with the stepping mechanism. Diodes CR1 through CR4 provide isolation between the two start ground circuits.

3.29 When start ground has been removed from the TTS 39XF, stepping switch RM will be driven to its home position by the ground applied to its homing circuit upon the release of relay SH. When reaching its home position, it will not be caused to advance to its first position as ground has been removed from the C wiper circuit by the release of SH.

3.30 The lead connecting from terminal 12 of terminal board TB1 to the coil circuit of RM is utilized for installations involving automatic programming of these units. The resistors connected to banks A and B, identified as HI-Z and LOW-Z on the schematic, are the resistors associated with the null network of the oscillator unit. Thus, as these resistors are switched by the operation of RM, the frequency generated by the oscillator unit will be switched accordingly.

TTS 39D Distribtuion Amplifier

3.31 The Model TTS 39D Distribution Amplifier panel provides mounting space for up to 4 output modules. This panel also contains a buffer amplifier and battery power control circuits. A schematic diagram of this unit is shown in Fig. 6.

3.32 This unit is normally supplied with the Model A buffer amplifier. A component placement diagram is shown in Fig. 6A. The purpose of the Model A buffer amplifier is to provide a relatively high impedance input to this unit. This buffer circuit consists of transistor Q1 and its associated circuitry. Transistor Q1 is operated as an emitter follower. Capacitor C2 and C3 provide DC blocking for the input and output of the buffer circuit. Resistors R1 and R2 and capacitor C1 provide voltage division and filtering.

Type 310 jacks marked INPUT and BUFFER OUTPUT have been provided for test purposes.

3.33 Battery fusing for this panel is supplied by fuse F1, battery power switching is supplied by switch S1, and reverse voltage protection is provided by diode CR1. The power ON indication is provided by pilot lamp PL1.

3.34 The oscillator input from terminal 12 of TB1 located on the TTS 39 generator unit must be connected to terminal IN-1 of the TTS 39D. For installations requiring more than one distribution amplifier, the IN-1 terminal of the second distribution amplifier is connected to the terminal marked BUFFER OUTPUT of the first distribution amplifier. By connecting in this manner the bridging impedance of only one distribution amplifier will be bridged across the oscillator output of the generator; thus, as many of these distribution amplifier units can be operated from a single source as required.

3.35 Distribution amplifiers, when operated in conjunction with multifrequency operation and/or options requiring timed interruptions and start circuits, must be supplied with the appropriate interconnections to the Model TTS 39A or B unit. All options available for use with the TTS 39A or B units may also be applied to the TTS 39D Distribution Amplifier.

3.36 Options

Option 1 - Provides a gas tube for tripping the ringing when the TTS 39A is used. No hold is included. A mounting space has been provided on the individual module units for the addition of gas tubes.

Option 2 - Includes a hold coil for tripping the ringing and providing a hold on the line when the TTS 39A is used. Mounting space has been provided on the module for the addition of hold coils.

Option 3 - Provides hold circuits and relays required to provide ON HOOK-OFF HOOK cycling; the hold coil also trips the ringing. This option is normally used only in conjunction with the TTS 39B; if an external source of interruptions is available, Option 3 may also be used with the TTS 39A. The start circuits contained in Option 3 may also be used to start frequency cycling when the TTS 39XF is used with the TTS 39B. A schematic of this circuitry is shown in Fig. 8. Mounting holes are provided on individual modules for the mounting of component boards containing the above circuitry.

Option 4 - Provides start circuits for initiating frequency cycling when the TTS 39XF is used in combination with the TTS 39A or the TTS 39B. This option is not required when Option 3 is provided. A schematic diagram of this option is shown in Fig. 8. Mounting holes have been provided on the individual modules for the mounting of component boards containing the above circuitry.

Option 5 - Combination of Options 1 and 4 for use with the TTS 39A.

Option 6 - Combination of Options 2 and 4 for use with the TTS 39A.

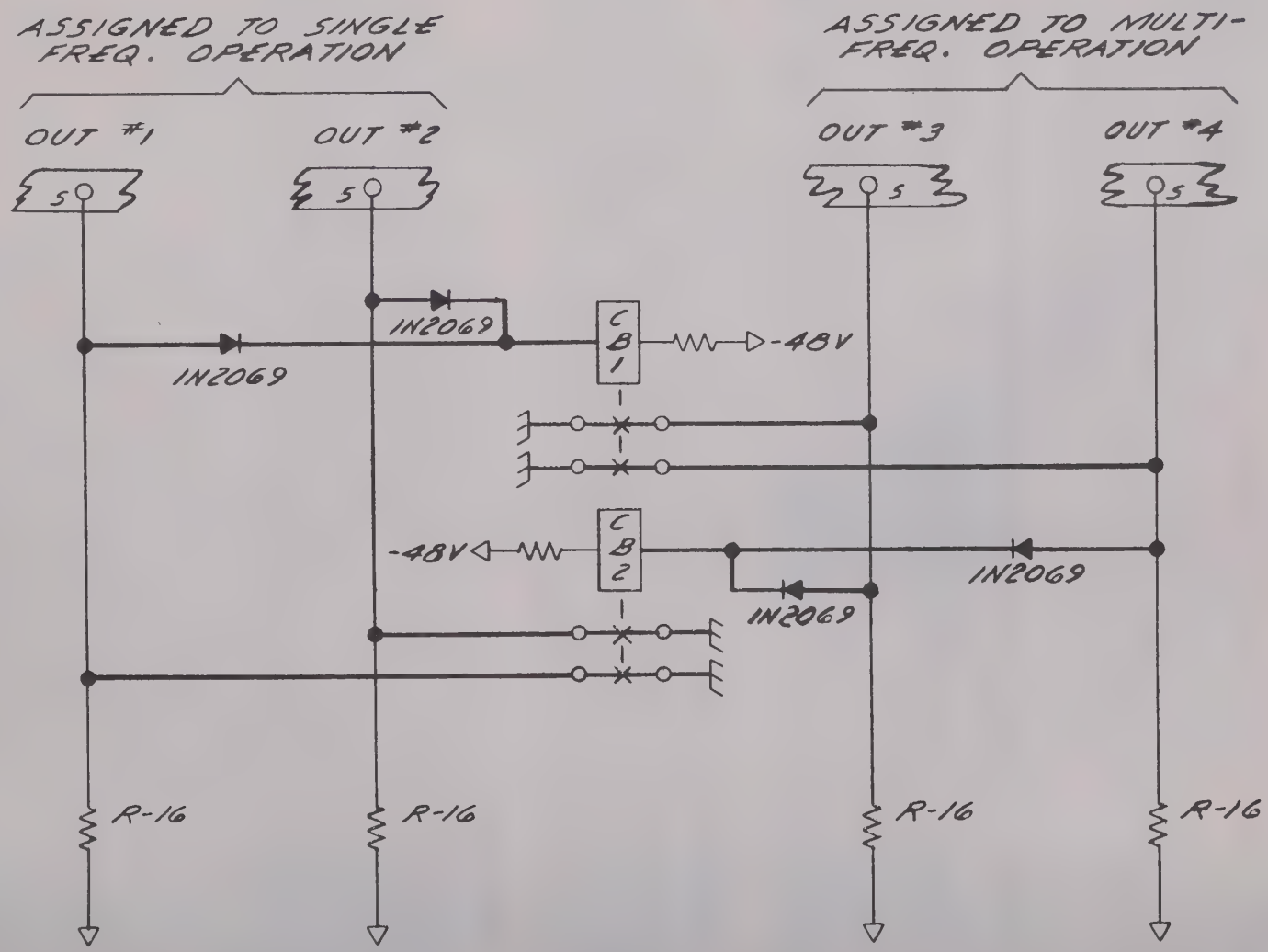
Other options are available, such as standard terminations, call party release, and other terminations. As these other various options are normally individually tailored to customer specifications specific details have not been included in this manual.

3.37 Frequency Cycling

The start circuitry for the TTS 39XF Frequency Cycling Adapter is shown in Fig. 7. For output modules to be associated with single frequency operations this circuitry is omitted. If this circuitry has been supplied, it can be disabled by lifting the lead connecting the contact of relay K1 to terminal D of TB1.

3.38 Cross Busy

For installations employing both cycling and non-cycling output circuits it may be desired to cross busy the output circuits to guard against frequency cycling appearing on an output assigned to single frequency operation. A typical example of this circuitry is shown on the next page. Ground, when applied to the sleeve of either or both outputs 1 and 2, will operate relay CB1, which in turn busies outputs 3 and 4. The operation of CB2 is identical to that of CB1. Mounting space has been provided on the output modules for these components.



CROSS BUSY CIRCUITS

4.0 CONTROLS AND ADJUSTMENTS

4.01 The following controls and jacks appear on the front panel of the TTS 39A or B:

1. Power switch and indicator lamp.
2. OSC TEST - monitor oscillator.
3. TEST jack for TTS 39XB Output Amplifier Modules.
4. COARSE level adjustment (locking) for TTS 39XB Output Amplifier Modules.
5. FINE level adjustment (locking) for TTS 39XB Output Amplifier Modules.

4.02 The TTS 39XF unit contains a HOME+PULSE indicator lamp. This lamp is lighted when the frequency selection switch is in its HOME position and flashes at each change of frequency.

4.03 The following controls and jacks appear on the front of the TTS 39D Distribution Amplifier Panel:

1. Power switch and indicator lamp.
2. TEST jack for TTS 39XB Output Amplifier Modules.
3. COARSE level adjustment (locking) for TTS 39XB Output Amplifier Modules.
4. FINE level adjustment (locking) for TTS 39XB Output Amplifier Modules.
5. Input level adjustment (optional) normalizes input level.
6. Input jack - monitor signal from oscillator .
7. Buffer output jack - monitor buffer output.

4.04 The following controls and jacks appear on the panel of the TCC 39 Carrying Case:

1. 48-volt jack - power input.
2. Output 1 to 4 - access to outputs.
3. Manual cycling switch - manual cycling start.

4.05 It is necessary to allow at least a half hour warm up period before any level adjustments are made. This amount of time is required for the temperature controlled oven containing the level stabilization element to reach its operating temperature. Normal output for units which have been adjusted for 0 dbm output will be in the order of +2.5 dbm when first turned on. This will decrease and stabilize at 0 dbm when the oven reaches its operating temperature. Level adjustments can be made with the COARSE and FINE adjustment, but this adjustment is to be made only after the oven has reached its operating temperature.

5.0 MAINTENANCE AND TROUBLE SHOOTING

5.01 Apart from occasional checks on the output levels, the TTS 39A and TTS 39B units do not require any routine maintenance.

5.02 If any abnormal operation occurs, it can easily be traced to one of the three groups of circuits. These circuits are as follows:

1. Oscillator and thermistor driving circuit.
2. Output amplifier circuits.
3. Time cycle generator circuit (TTS 39B).

5.03 When there is no output at any of the output amplifiers, the trouble is most likely to be located in the oscillator and thermistor driving circuits and trouble shooting should be conducted as follows:

1. Referring to Fig. 2A, connect the high side of a VTVM to point A and the low side to the low side of resistor R90 (ground) on the oscillator board. The voltage should be 1.5 volts RMS at these points. If it is not, adjust R15 for this level. Turning R15 with a screwdriver clockwise increases the positive feedback and therefore increases the output level appearing at point A. There should be no fluctuation of the signal level at this point once the level is adjusted to 1.5 volts RMS.

2. If there is no voltage between point A and ground (with R15 in maximum clockwise position), check the filament of the tungsten lamp for continuity. Replace if faulty. If the lamp is good, replace the transistors, starting with Q1 and ending up with Q3. If trouble still prevails, check for proper DC voltage as indicated on the schematic diagram of the circuit. These voltages should be within ±10% as indicated.

3. When the preceding steps fail to produce an output at point A, check other components contained in the oscillator circuit, such as resistors, capacitors, and the frequency switching relays. It is important after correction of the trouble to readjust the voltage appearing at point A and ground to 1.5 volts RMS.

5.04 With the oscillator operating properly, check the RMS voltage appearing between pins 2 and 7-8 of the oven. This voltage should be in the order of 1.1 volts RMS; the exact voltage depends upon the characteristics of the individual thermistor within the oven itself. The oven must be at normal operating temperature

for this measurement. If no voltage appears at pin 2 of the oven, check the thermistor driving portion of the circuit. This circuit consists of transistors Q4, Q5, Q6, and their associated circuitry. After this circuit has been restored to normal operating condition, check the operating point of the thermistor. This is covered under Thermistor Operating Level Adjustment below.

5.05 If the voltage appearing across the thermistor (between pins 2 and 7 of the oven) is found to be excessive, check the thermistor for continuity as this indicates an open thermistor. If the thermistor is found to be defective, installation of a new oven unit is recommended.

Thermistor Operating Level Adjustment

5.06 The thermistor driving voltage has been factory adjusted and should require further adjustment only when replacement of the oven unit has become necessary. For this adjustment the oven must be at its normal operating temperature and the oscillator voltage appearing at the emitter of Q2 should be 1.5 volts RMS. Refer to Figure 2A for the preceding component locations.

5.07 To perform the thermistor level adjustment, remove the protective front cover and connect the high side of a VTVM to the emitter of Q6 (2N1136A) and the low side to ground. Connect an output level meter such as a Model TTS 4AN or equivalent into one end of the test jacks. Advance adjustable resistor R19 (located on the oscillator board) to a full clockwise position. Observe the output level and very slowly rotate R19 in a counter clockwise direction to a point where the output level no longer continues to rise as R19 is turned. If necessary, repeat the preceding operation in order to definitely establish this point. The thermistor is now being driven to the beginning of its so-called "hump." Observe the VTVM which should now show a reading of approximately 4 to 5 volts RMS (the exact voltage depends on the characteristics of the individual thermister), and further rotate R19 to a position that increases the VTVM reading by 1 volt.

Output Amplifier

5.08 When one output circuit is inoperative and the others are functioning normally, it can be assumed that the preceding oscillator and thermistor driving circuit is operating satisfactorily. Trouble shooting should be conducted on the inoperative output stage as follows:

1. With reference to Fig. 3A, substitute transistors Q1, Q2, and Q3, then recheck for output. If trouble still exists, advance both output level controls (COARSE and FINE) to their full clockwise positions. With the unit on, check the DC voltage at the negative end of capacitor C5; it should read 24 volts DC ±10%. Connect the

high side of a VTVM to the junction of R2 and R5 (base of Q1) and the low side to ground. The AC signal voltage at this point should be in the order of .5 volts RMS. If it is not, trouble will probably be found in the output level adjustment controls or the DC blocking capacitor C1. Excessive output level is an indication of an open resistor or defective oven unit.

2. If the signal voltage measured at the base of Q1 is found to be normal, measure the signal voltages appearing at the collector of Q1 and the emitters of Q2 and Q3. The AC signal voltages at these points should be in the order of 2.8 volts RMS. If these voltages are found to be normal, connect the high side of the VTVM to terminal 4 (green lead) of transformer T1 and the low side to terminal 1 (black and white lead) of transformer T1. The AC signal voltage should read in the order of 2.8 volts RMS (no load on output). If no signal appears at this point, check DC blocking capacitor C4 and transformer T1 for an open circuit. If the signal voltage measured is low and capacitor C4 is found to be normal, check transformer T1 for shorted turns by measuring the DC resistance of the windings. With the transformer in the circuit (power removed from the unit), the following resistances should be realized; if they are not, replace the transformer.

Terminal 5 to Terminal 8	40-60 ohms
Terminal 1 to Terminal 2	20-30 ohms
Terminal 3 to Terminal 4	20-30 ohms

The above readings are approximate and will vary with individual transformers.

3. Should the signal voltage measured at terminals 1 and 4 of T1 be normal, then capacitor C4 and resistors R12 and R13 should be checked. Contacts of test jack J1 must make a good connection in order for the signal to reach the ring and tip contacts on the terminal board. No signal should appear on the terminal board when a plug is inserted into the test jack.

4. After trouble has been corrected, readjust the COARSE and FINE adjustment controls to the desired output level. The oven must be at normal operating temperature for this adjustment.

5. To check the ringing voltage protection network, consisting of diodes CR1 and CR2 and resistor R11, disable the oscillator by removing transistor Q1. Apply ringing voltage to output ring and tip terminals. Measure the DC emitter voltage of Q3. This voltage should be within 2 volts of the collector voltage of Q3; if it is not, locate

and replace the defective component within this network. It is important that this network be in proper operating order, as this supplies the ringing voltage protection to transistors Q2 and Q3, and capacitor C3.

TTS 39XF Frequency Cycling Adapter

5.09 Trouble shooting of this unit can, for the most part, be accomplished by substituting relays SH, DF, and D. Should this fail to correct the trouble, other components C1 and diodes CR1 through CR4 should be checked. Resistors identified as HI-Z and LOW-Z are the frequency determining resistors for the oscillator section of the TTS 39 and have no effect on the switching or timing of this unit.

5.10 It should be noted that relay D has been provided with a special adjustment. This adjustment consists of turning the break contact out to eliminate the air gap between the armature and the pole piece of the relay when operated. This delays the release, thus providing a much longer time constant than would otherwise be realized.

Time Cycle Generator

5.11 Should the Time Cycle Generator unit fail to operate after applying ground to the start (S) terminal, the trouble will most likely be traced to dirty relay contacts. If the unit does not operate after cleaning the contacts of K1 and K2, other components such as Q1, C1, CR1, and R1 through R6 should be checked.

5.12 The value of resistor R6 determines the charge time of C1 and the value of resistor R5 determines the discharge time of 10 seconds. Any change in the values of C1, R5, or R6 will change the timing of the unit.

6.0 INSTALLATION INSTRUCTIONS

6.01 Before attempting to connect and operate the Model TTS 39A or B Reference Tone Generator, perform a visual inspection of the unit to insure that damage has not been caused during shipment, such as components being pushed together, etc.

6.02 Installers wiring and interconnection is shown in Installation Diagram, Fig. 9.

6.03 Connect a well filtered 48-volt DC source to terminals 1 and 2 of terminal board TB1, located on the rear of the unit. Positive (+) is to be connected to terminal 2, and negative (-) to terminal 1. If polarity is reversed, the unit will not operate.

6.04 The unit is designed to operate over a voltage range of 44 to 52 volts at terminals 1 and 2. A direct line to the DC buss should be provided. If this is not feasible, thorough tests must be made to insure that the supply voltage at terminals 1 and 2 will always be within this range regardless of the other loads which may be connected to or disconnected from the common supply line.

6.05 Each of the TTS 39XB Input Amplifier Modules of the TTS 39A or B is normally connected to an especially assigned subscriber number in the dial equipment. The line circuits normally associated with these subscriber appearances must be disconnected. This is necessary to avoid a permanent off-hook condition in the line circuit, and to remove all DC voltages from the R-T leads when the TTS 39A or B is in the idle condition.

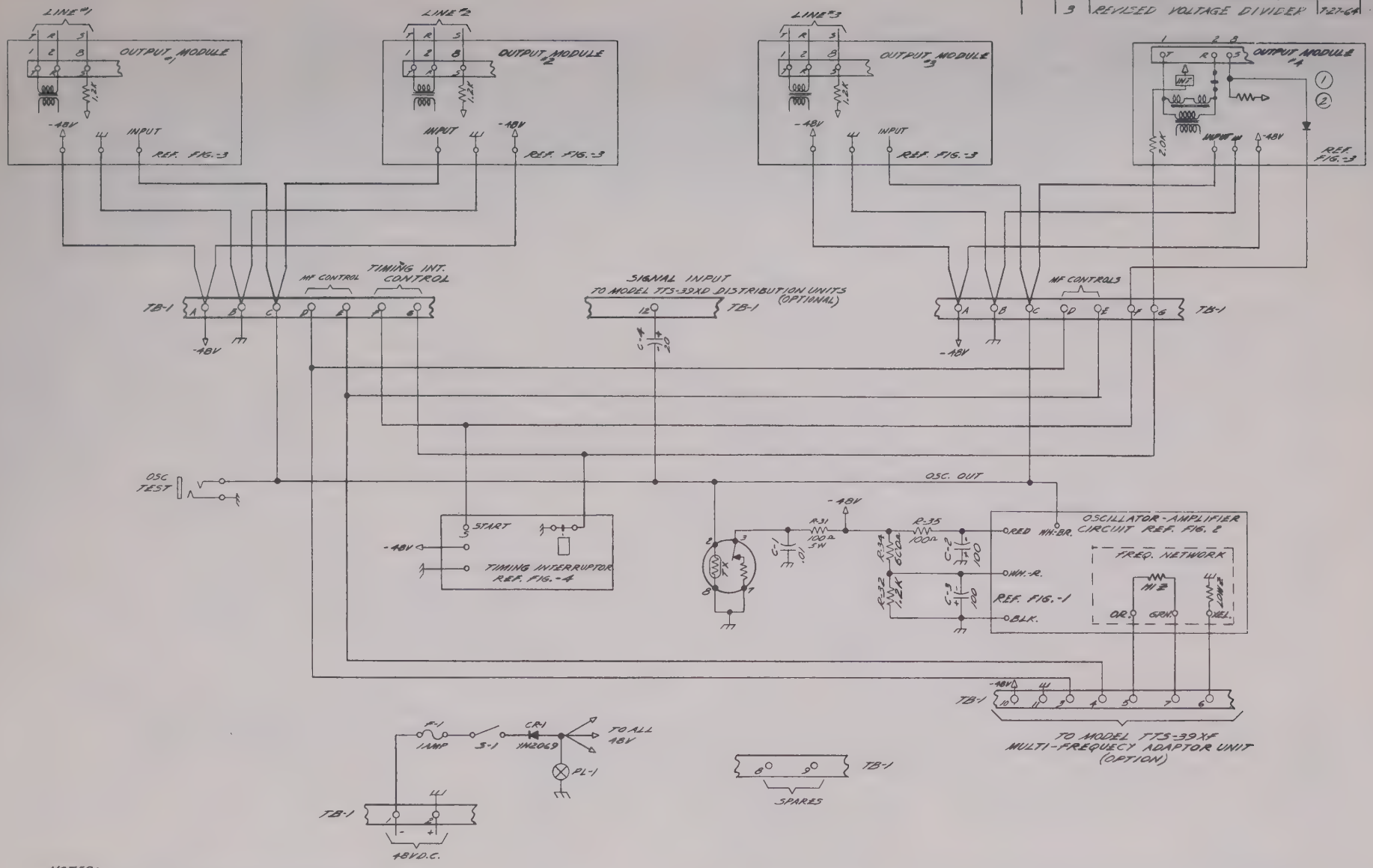
6.06 The tip, ring, and sleeve of each subscriber number assigned to the TTS 39A or B should be connected to terminals 1, 2, and 8 respectively on each TTS 39XB Output Amplifier Module.

6.07 Each TTS 39XB Output Amplifier Module can be arranged for either 600 or 900 ohm output impedance. Installation Diagram Fig. 9 shows the correct strap to be added or deleted for the different impedance.

6.08 Should the impedance of a TTS 39XB be changed in the field, the level should be readjusted to meet the correct requirements.

6.09 Before attempting the above level adjustments it is important to allow a half hour warm up period, as this period of time is required for the temperature controlled oven to reach operating temperature.

REVISIONS			SIZE	REV
			CONT ON SHEET	SH NO
ZONE	SYM	DESCRIPTION	DATE	APPROVAL
	1	MINOR CHANGES & ADDITIONS	3-6-64	L.B.S.
	2	CHANGED OUTPUT #4 (MEMO BY NBW)	4-27-64	D.C.K.
	3	REVISED VOLTAGE DIVIDER	7-27-64	J.K.



NOTES:
① CIRCUITRY OF OUTPUT #4 ARRANGED TO PROVIDE TIMED OFF HOOK INTERRUPTIONS TOTAL SLEEVE RESISTANCE TO BATT = 1200Ω

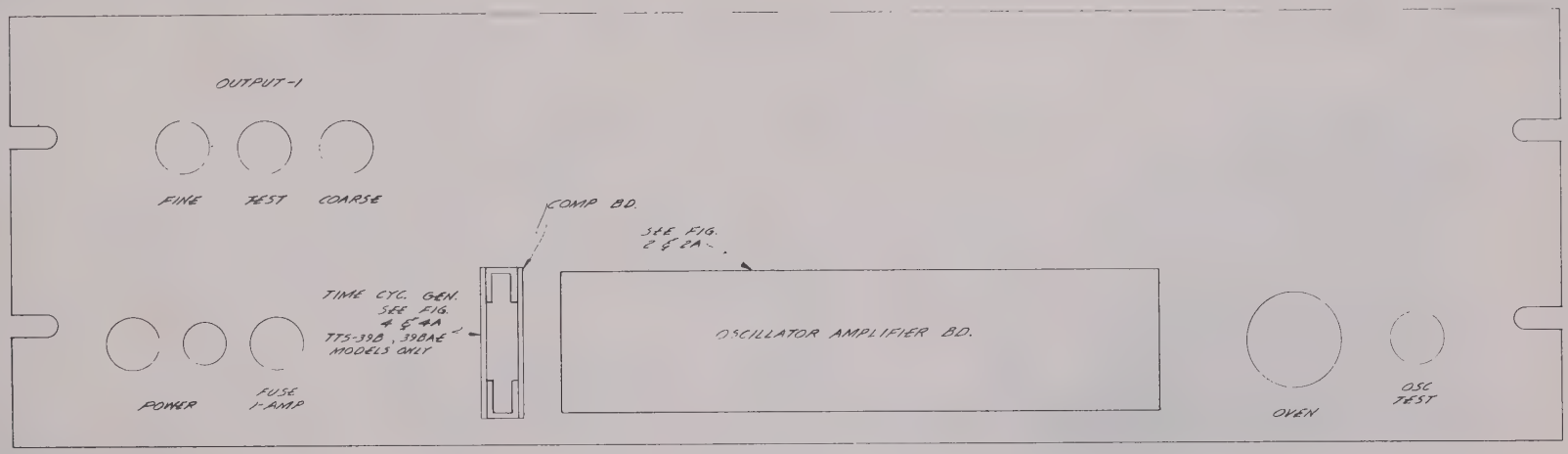
FIG. 1

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS ±1/64 DECIMALS ±.005 ANGLES ±½°
ALL SURFACES
MATERIAL
FINISH
PAINT

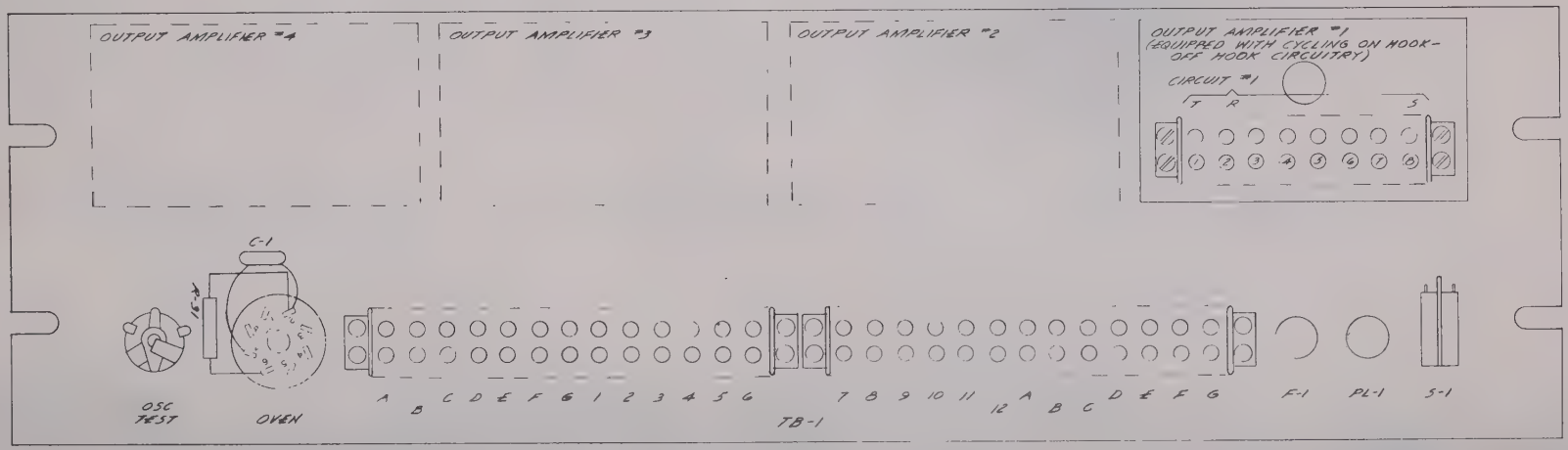
DRAWN	K.A. SMITH	
DATE	1-10-64	
APPD		
ISSUED		
	APPROVED	DATE
ENGR		
MFG		

SCHEMATIC
IKC
REFERENCE TONE COENERATOR
TTS-39A
TTS-39B
TTS-39BAE

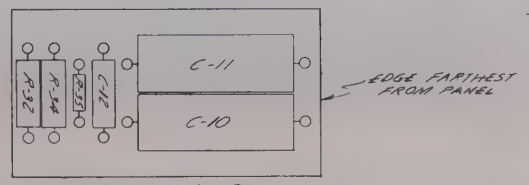
NORTHEAST ELECTRONICS CORP
CONCORD, N. H.
REF. NO. C-1191
SIZE C 60500 1



FRONT



REAR



COMPONENT BOARD

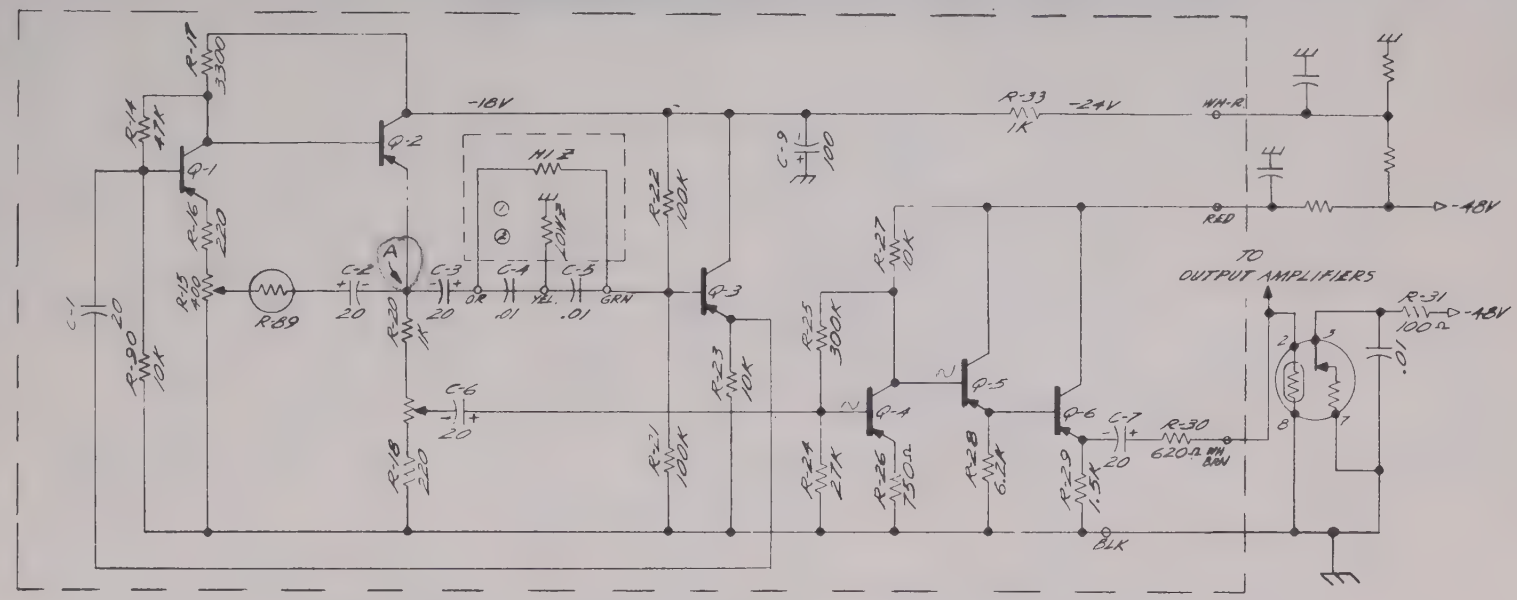
FIG. 1A

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS ±1/64 DECIMALS ±.005 ANGLES ±½° ALL SURFACES MATERIAL FINISH PAINT SCREEN PER	DRAWN LEO B. GAGNON DATE 11-3-64 APPD. ISSUED APPROVED / DATE ENGR MFG MATL SCALE WT CALC / ACTUAL	PANEL ASSEMBLY TTS-39A TTS-39B TTS-39BA	NORTHEAST ELECTRONICS CORP. CONCORD, N H REF NO C-1181 SIZE C 60719 CONT ON SHEET SH NO

REV	SIZE	CONT ON SHEET	SH NO

REVISIONS

SYM	DESCRIPTION	DATE	APPROVAL
1	CHANGED VALUES	8-19-64	G.W.S



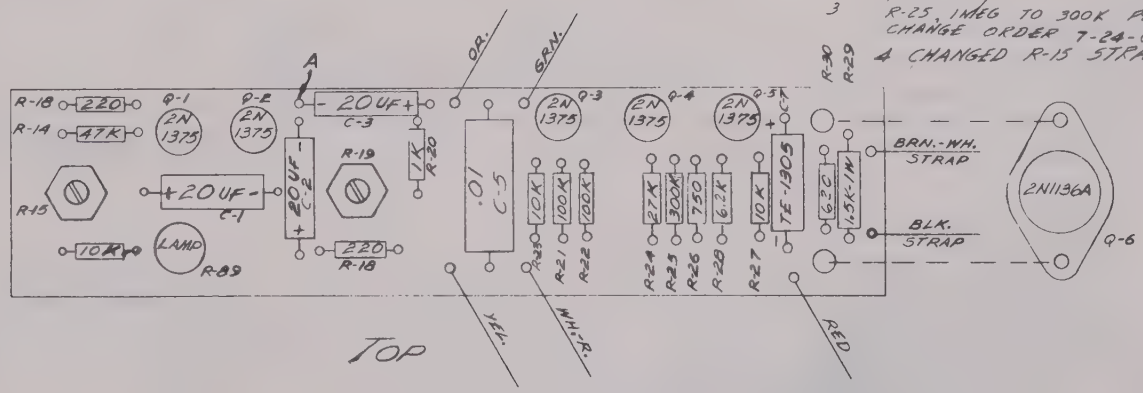
NOTES:

1. SELECTED VALUES TO PROVIDE DESIRED FREQUENCY
2. OMIT FOR MULTI-FREQUENCY OPERATION

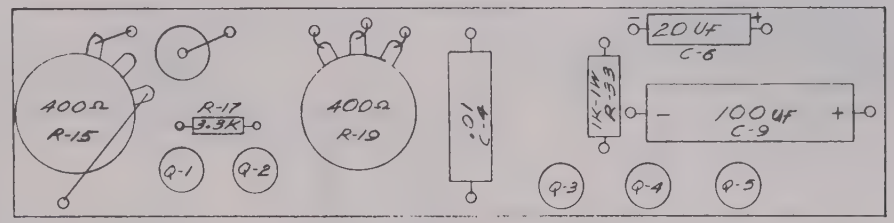
FIG. 2

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS ±1/64 DECIMALS ±.005 ANGLES ±½° ALL SURFACES	DRAWN K.A. SMITH DATE 1-10-64 APPD ISSUED	SCHEMATIC OSCILLATOR AMPLIFIER PRINTED CIRCUIT	NORTHEAST ELECTRONICS CORP. CONCORD, N. H.
MATERIAL	APPROVED / DATE		REF. NO.
FINISH PAINT SCREEN PER	ENGR MFG MATL		SIZE B 40477
	SCALE	WT CALC ACTUAL	CONT ON SHEET SH NO

REVISIONS				SIZE		REV
				CONT ON SHEET	SH NO	
SYM	DESCRIPTION			DATE	APPROVAL	
1	REDRAWN			10/31/63	K.A.S	
2	changed resistor values per change order 1-11-63			9-4-63		
3	R-25, 1MEG TO 300K PER CHANGE ORDER 7-24-64			8-17-64	L.B.G.	
4	CHANGED R-15 STRAPPING			9-10-64		



TOP

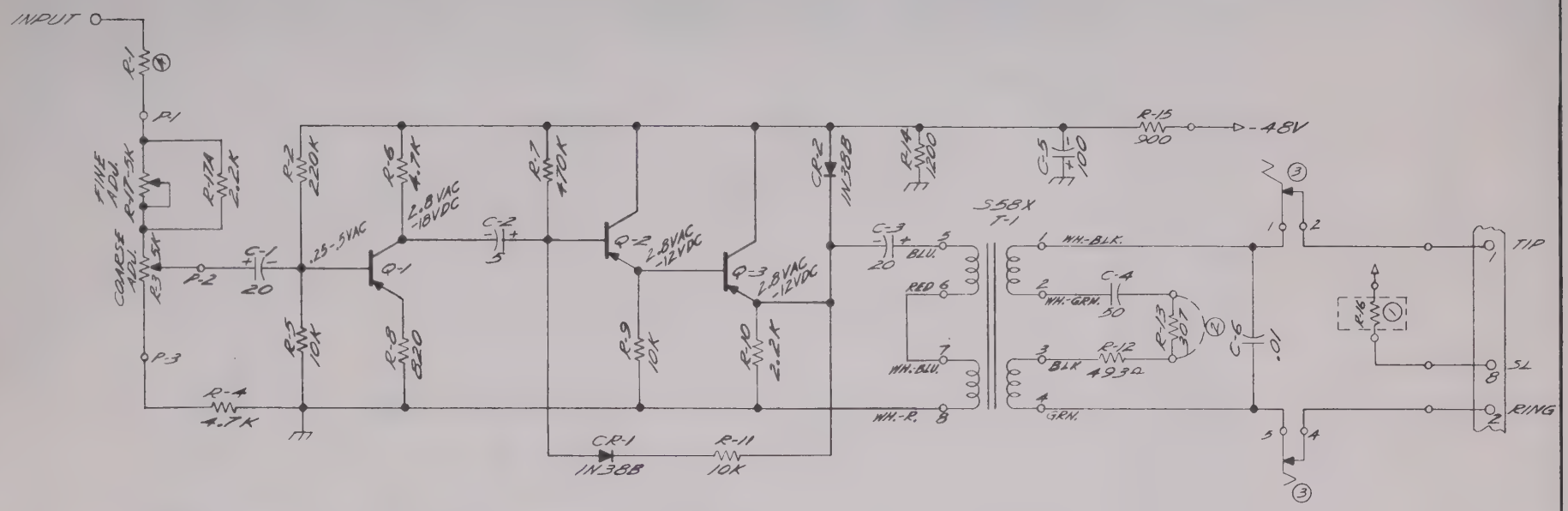


BOTTOM

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON: FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES ± 1/2° ALL SURFACES ✓	DRAWN L.B. GAGNON	ASSEMBLY	Northeast Electronics Corp. Concord, N. H.
	DATE 6-2-61	TOP P.C. BOARD	REF. B-1117
	APPD		SIZE B 40130
	ISSUED		
MATERIAL	APPROVED / DATE		
	ENGR	TTS-95 AND TTS-39	
FINISH	MFG		
	MATL	SCALE / WT CALC ACTUAL	CONT ON SHEET / SH NO.

FIG. 2A

REVISIONS				REV
SYM	DESCRIPTION	DATE	APPROVAL	
3	REDRAWN	8-19-64	KAS	



NOTES:

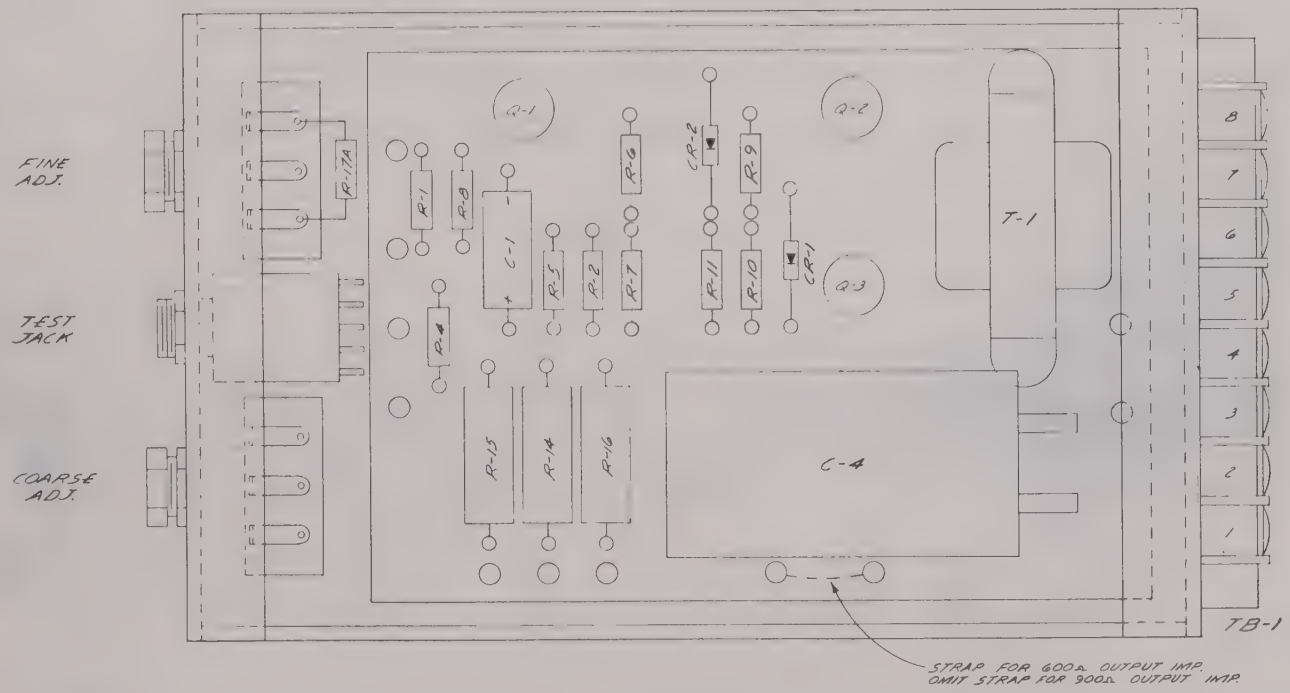
1. SLEEVE RESISTANCE NORMALLY SUPPLIED = 1200Ω
2. INSERT STRAP FOR 600Ω, REMOVE FOR 900Ω
3. TEST JACK
4. SELECTED VALUE TO PROVIDE DESIRED OUTPUT RANGE

NEC-E-95023 P.C.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS ±1/64 DECIMALS ±.005 ANGLES ±½° ALL SURFACES	DRAWN K.A. SMITH	SCHEMATIC OUTPUT AMPLIFIER	NORTHEAST ELECTRONICS CORP.
MATERIAL	DATE 8-14-64		CONCORD, N. H.
	APPD		REF. NO. B-
	ISSUED	TTS-39XB	SIZE B 40478
FINISH	APPROVED / DATE		
PAINT	ENGR		
SCREEN PER	MFG		
	MATL	SCALE / WT CALC ACTUAL	CONT ON SHEET / SH NO

FIG. 3

REVISIONS					SIZE	REV
					CONT ON SHEET	SH NO
ZONE	SYM	DESCRIPTION		DATE	APPROVAL	



TOP VIEW

FIG. 3A

ITEM	REQ'D	PART NO	DESCRIPTION	MATL	MATL SPEC

LIST OF MATERIAL

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON FRACTIONS ±1/64 DECIMALS ± .005 ANGLES ± ½°
ALL SURFACES √
MATERIAL
FINISH
PAINT
SCREEN PER

DRAWN LEO B. GAGNON
DATE 9-16-64
APPD
ISSUED

	APPROVED	DATE
ENGR		
MFG		
MATL		

OUTPUT MODULE ASSEMBLY

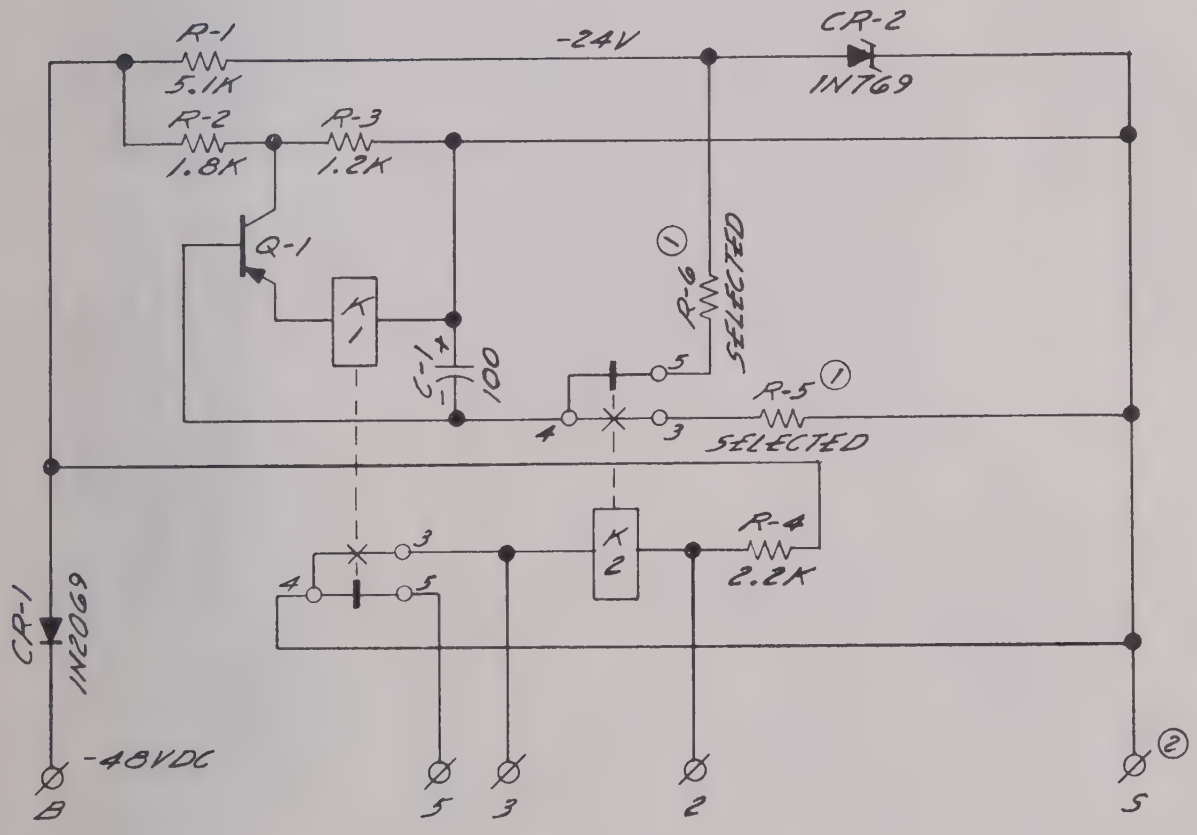
TTS-39

SCALE WT CALC ACTUAL

NORTHEAST ELECTRONICS CORP.
CONCORD N H
REF NO C-1191
SIZE C 60698
CONT ON SHEET SH NO

NOTE:

① SELECTED TO PROVIDE DESIRED TIMING.
② TO START APPLY GROUND TO TERM. "5"

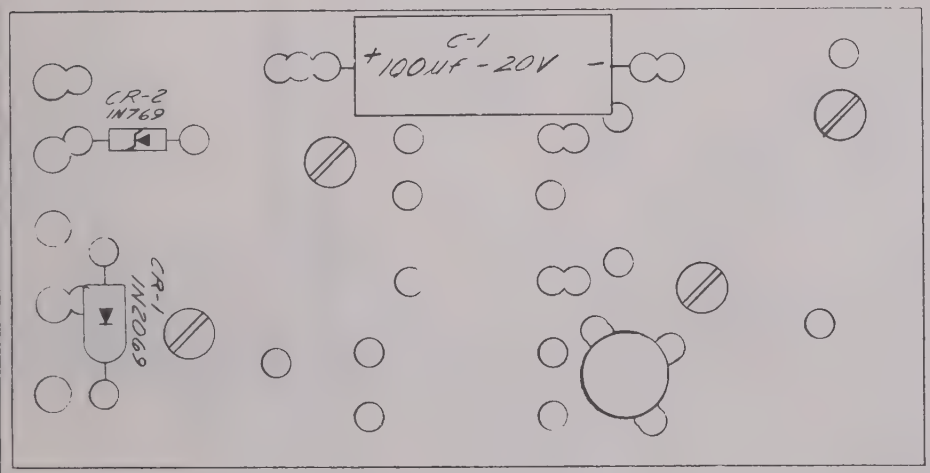


SCHEMATIC
TIME CYCLE GENERATOR

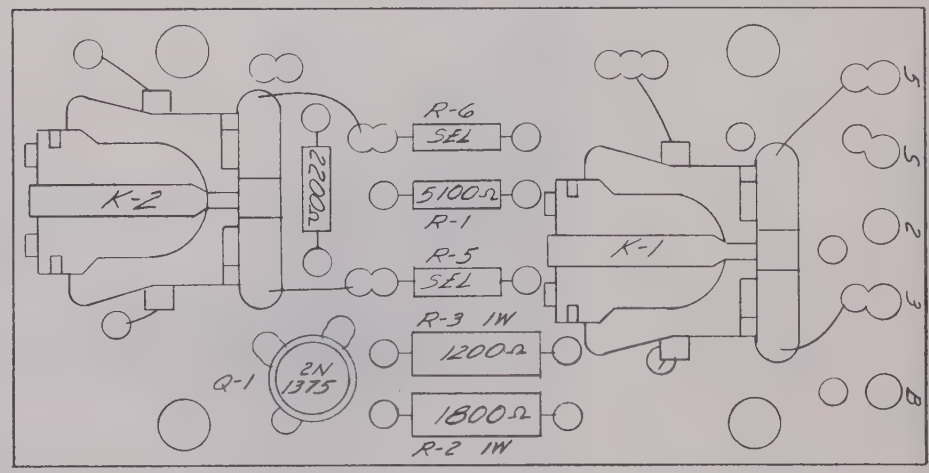
FIG.-4
A-10635

REVISIONS	SIZE	REV
	CONT ON SHEET	SH NO

SYM	DESCRIPTION	DATE	APPROVAL



REAR VIEW



FRONT VIEW

FIG. 4A

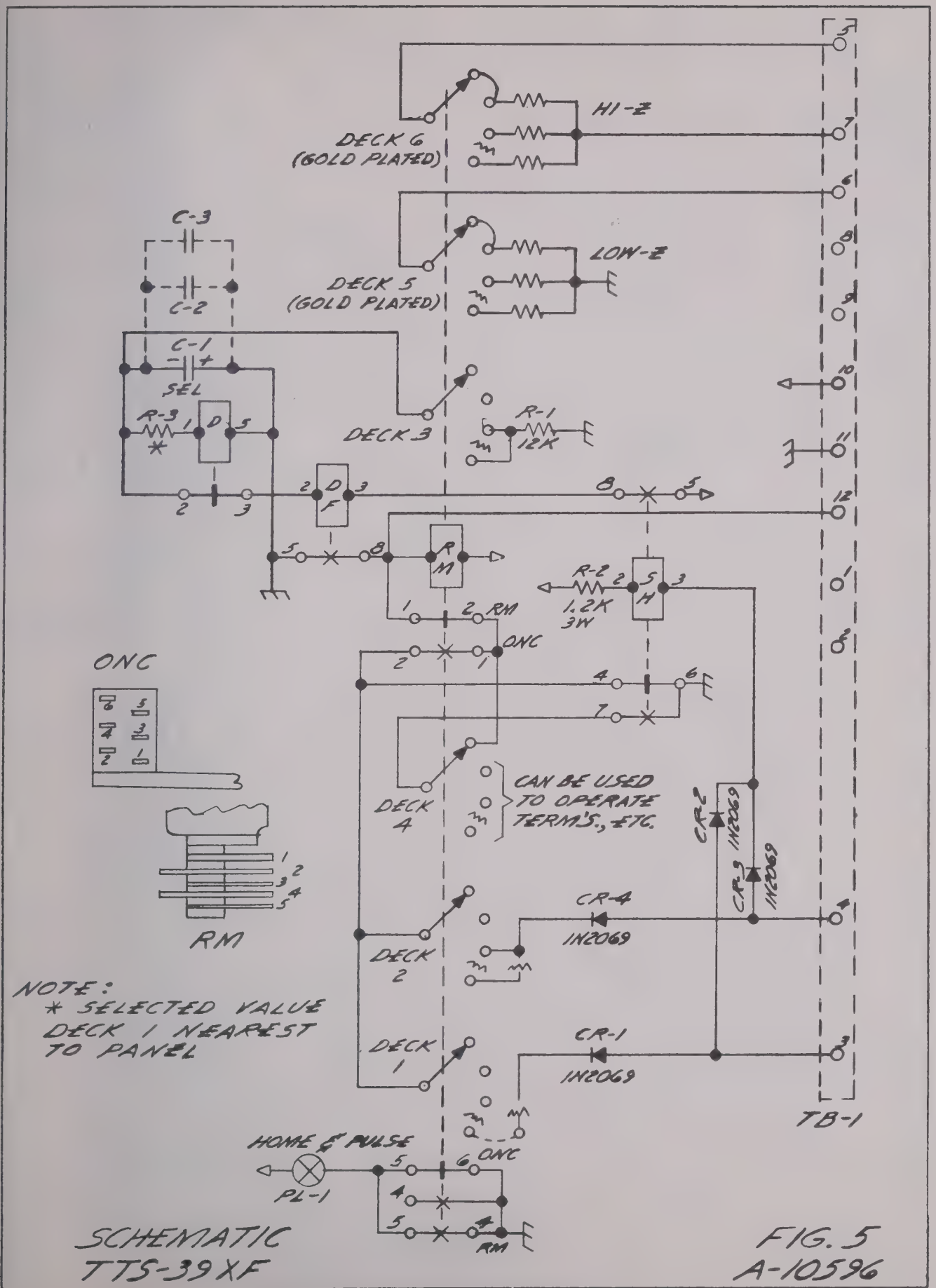
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS ±1/64 DECIMALS ±.005 ANGLES ±½° ALL SURFACES	DRAWN K.A. SMITH
MATERIAL	DATE 10-21-64
	APPD
	ISSUED
FINISH	APPROVED / DATE
PAINT	ENGR
SCREEN PER	MFG
	MATL

ASSEMBLY
P.C. BOARD

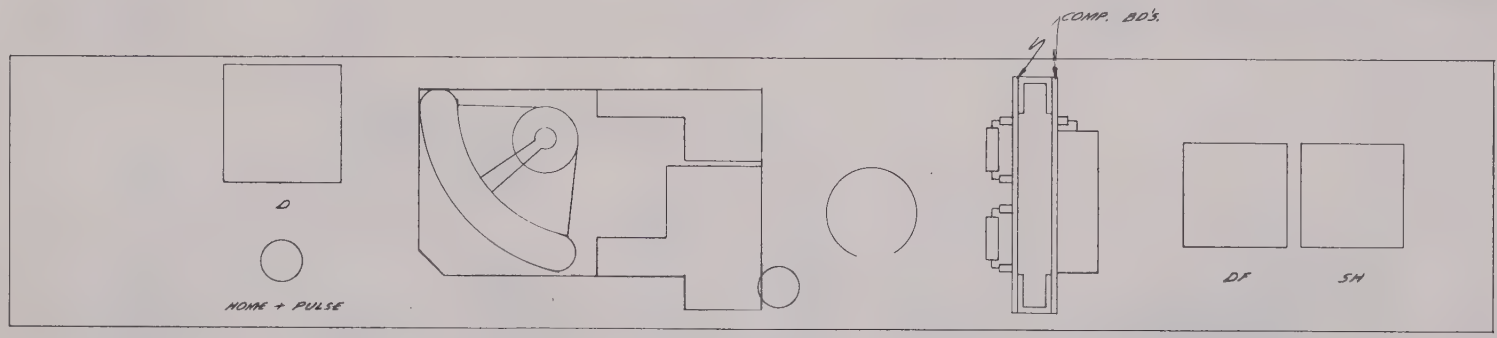
TIME CYCLE GEN.

SCALE | WT CALC ACTUAL

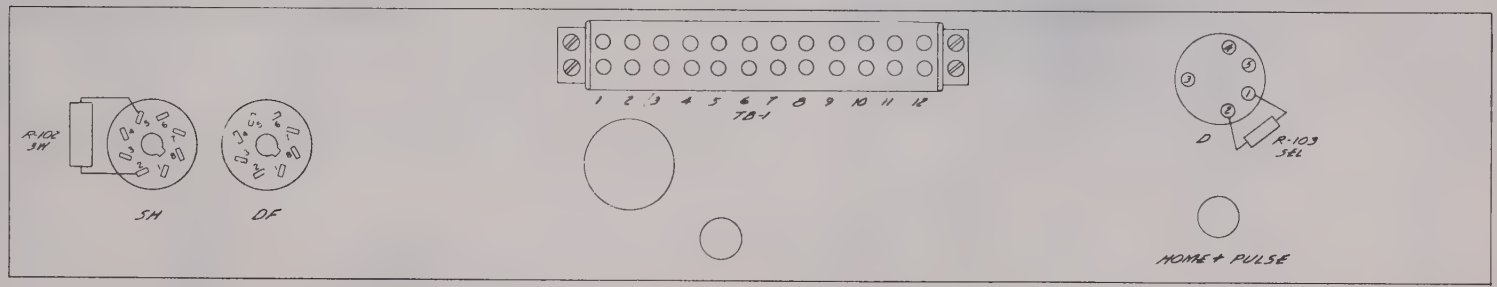
NORTHEAST ELECTRONICS CORP.
CONCORD, N. H.
REF. NO. B-1198
SIZE B 40690
CONT ON SHEET SH NO


HI-Z
DECK 6
(GOLD PLATED)
LOW-Z
DECK 5
(GOLD PLATED)
C-3
C-2
C-1
SEL
R-3
DECK 3
R-1
12K
R-2
1.2K
3W
RM
ONC
DECK 4
CAN BE USED TO OPERATE TERM'S., ETC.
CR-2
CR-3
IN2069
CR-4
IN2069
DECK 2
CR-1
IN2069
DECK 1
HOME & PULSE
PL-1
TB-1
NOTE:
* SELECTED VALUE
DECK 1 NEAREST
TO PANEL
SCHEMATIC
TTS-39XF
FIG. 5
A-10596

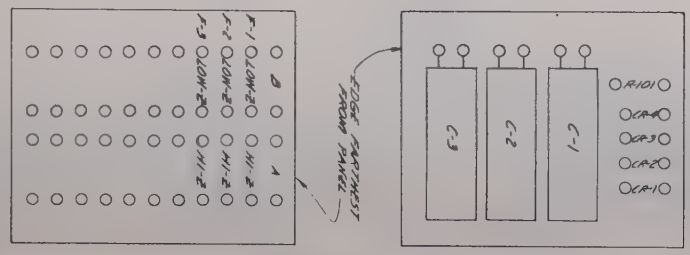
REVISIONS				SIZE	REV
				CONT ON SHEET	SH NO
ZONE	SYM	DESCRIPTION	DATE	APPROVAL	



FRONT



REAR



COMPONENT BOARDS

FIG. 5A

ITEM	REQ'D	PART NO	DESCRIPTION	MATL	MATL SPEC
LIST OF MATERIAL					

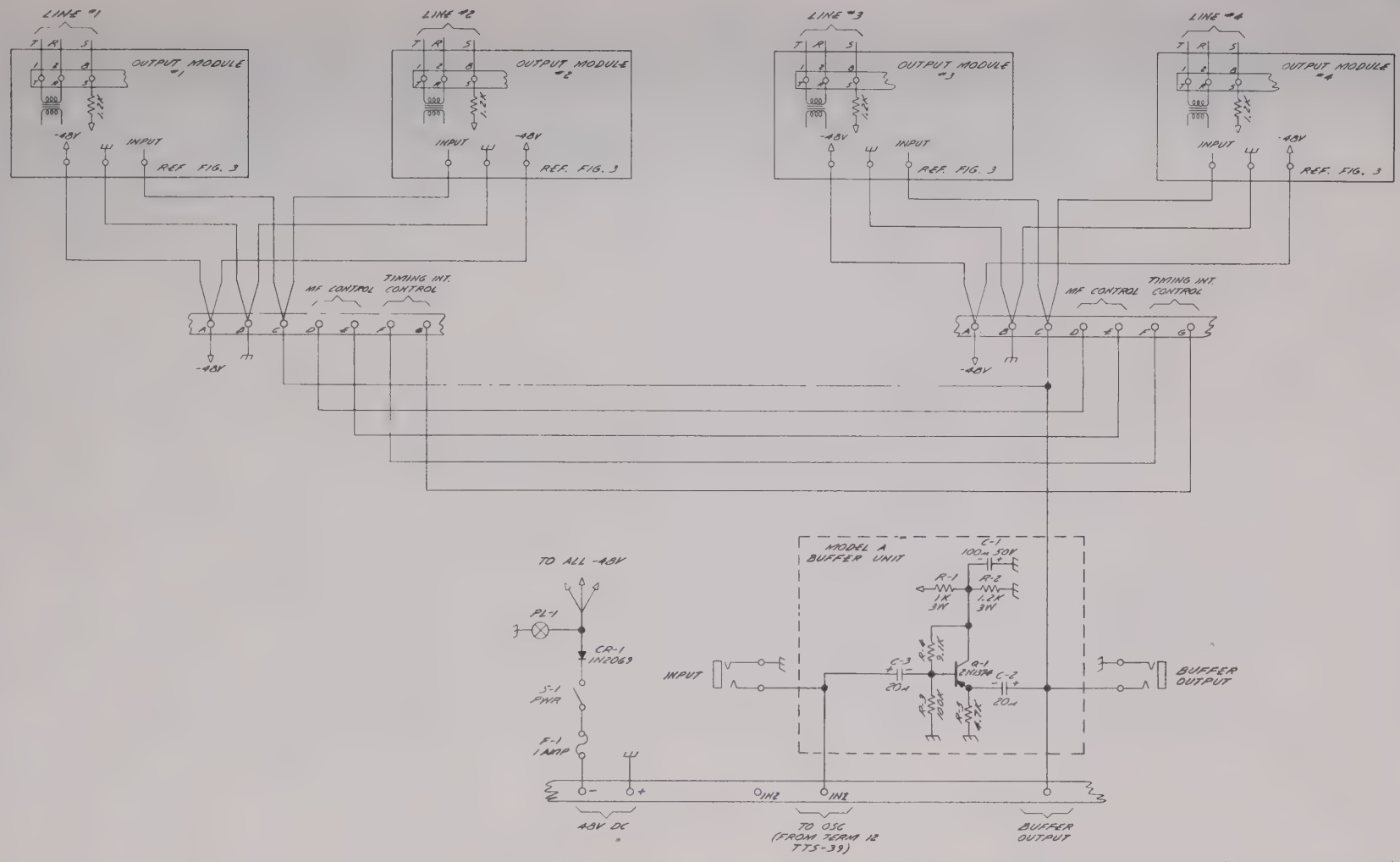
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES ± ½°
ALL SURFACES ✓
MATERIAL
FINISH
PAINT
SCREEN PER

DRAWN LEO B. GAGNON
DATE 11-2-64
APPD
ISSUED
APPROVED | DATE
ENGR
MFG
MATL

PANEL ASSEMBLY
TTS-39XF
SCALE | WT CALC ACTUAL

NORTHEAST ELECTRONICS CORP.
CONCORD, N. H.
REF NO C-1157
SIZE C 60717
CONT ON SHEET SH NO

REV		
SIZE	CONT ON SHEET	SH NO



REVISIONS				SIZE	REV
				CONT ON SHEET	SH NO
ZONE	SYM	DESCRIPTION	DATE	APPROVAL	
	1	MINOR CHANGES	8-6-64	BJK	

ITEM	REQ'D	PART NO	DESCRIPTION	MATL	MATL SPEC

LIST OF MATERIAL

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON FRACTIONS ±1/64 DECIMALS ±.005 ANGLES ±½°
ALL SURFACES
MATERIAL
FINISH
PAINT
SCREEN PER

DRAWN LEO B. GAGNON
DATE 9-7-64
APPD
ISSUED
APPROVED DATE
ENGR
MFG
MATL

SCHEMATIC DISTRIBUTION AMPLIFIER

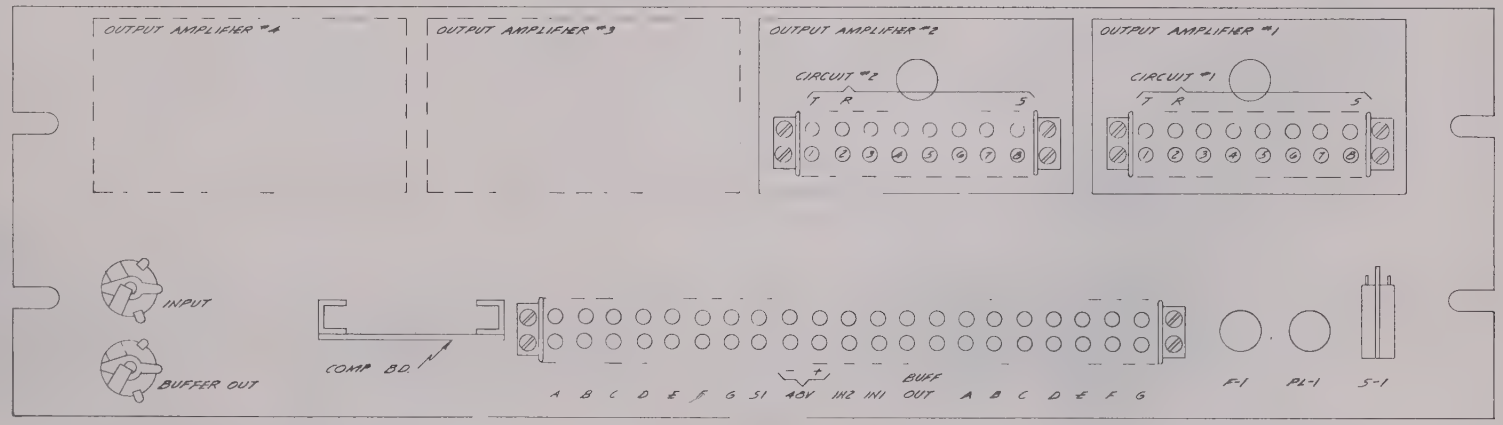
TTS-39D

SCALE WT CALC ACTUAL

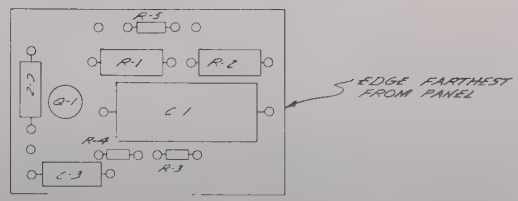
NORTHEAST ELECTRONICS CORP.
CONCORD, N. H.
REF. NO. C-1191
SIZE C 60673
CONT ON SHEET SH NO

FIG. 6

REVISIONS				SIZE	REV
ZONE	SYM	DESCRIPTION	DATE	APPROVAL	CONT ON SHEET SH NO



REAR



COMPONENT BOARD

FIG. 6A

ITEM	REQ'D	PART NO	DESCRIPTION	MATL	MATL SPEC

LIST OF MATERIAL

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON FRACTIONS ±1/64 DECIMALS ±.005 ANGLES ±½°
ALL SURFACES
MATERIAL
FINISH
PAINT
SCREEN PER

DRAWN LEO A. GAGNON
DATE 11-6-64
APPD.
ISSUED

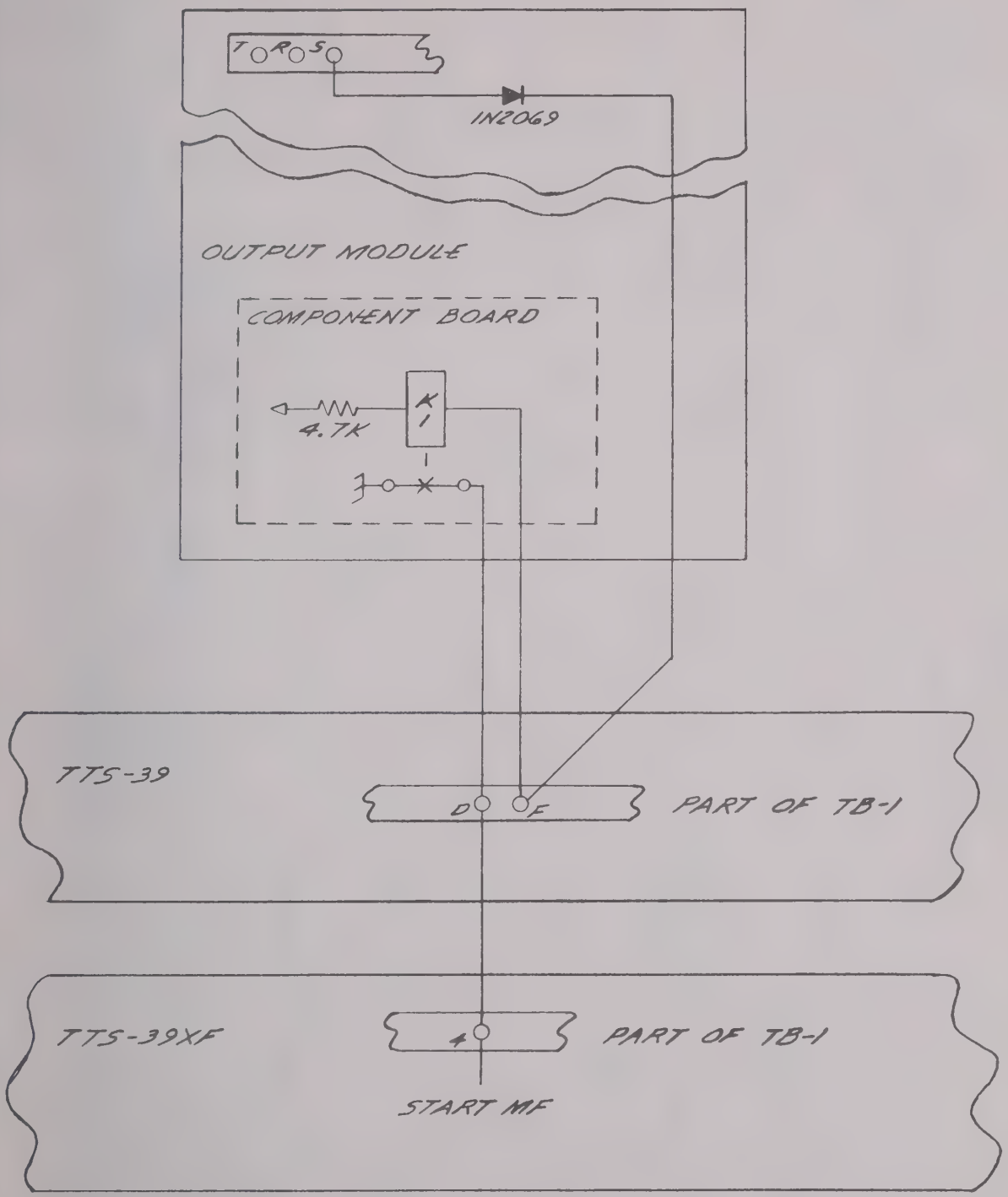
APPROVED	DATE
ENGR	
MFG	
MATL	

PANEL ASSEMBLY

TTS-39D

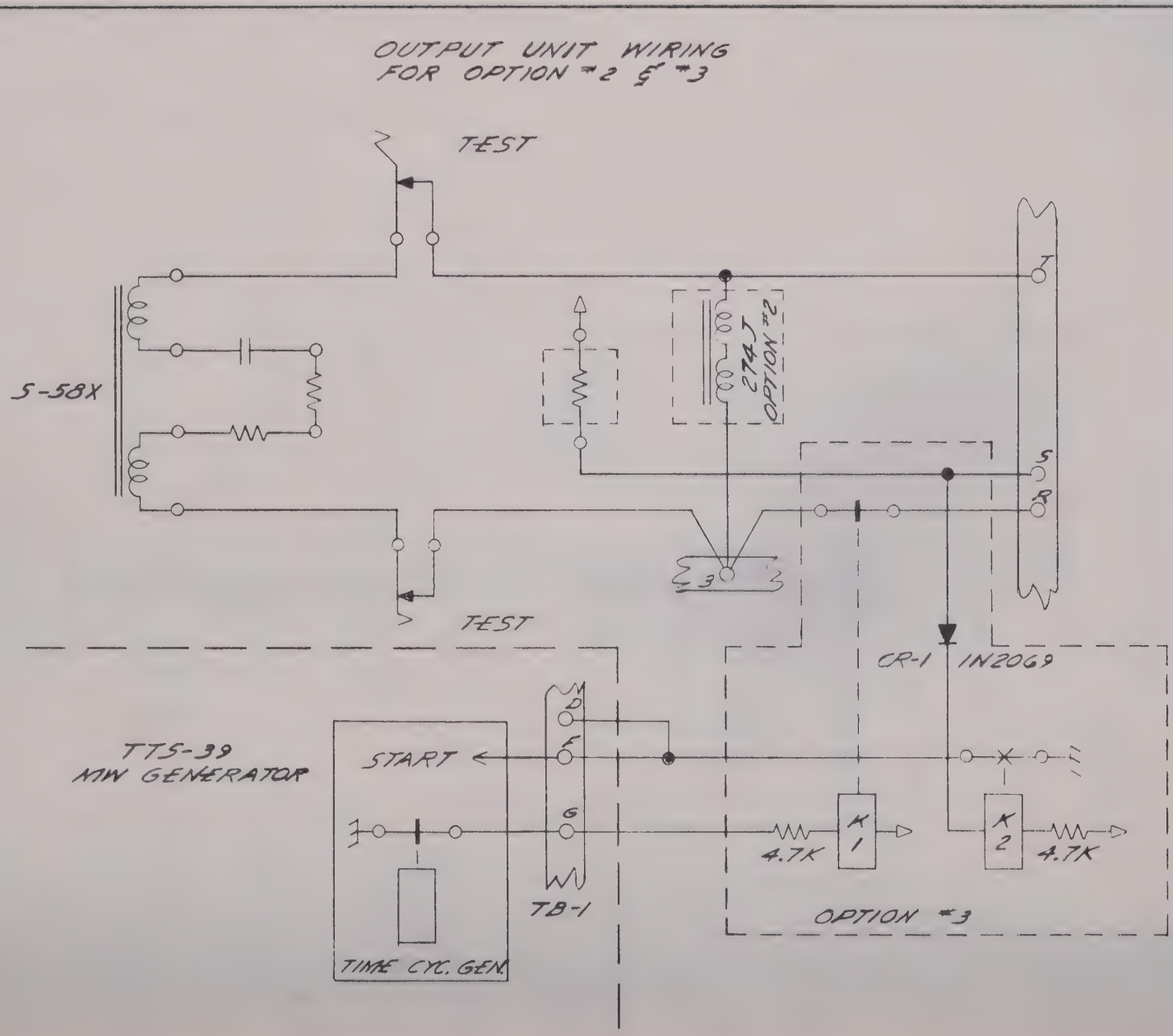
SCALE WT CALC ACTUAL

NORTHEAST ELECTRONICS CORP.
CONCORD N. H.
REF NO. C-1157
SIZE C 60718
CONT ON SHEET SH NO



OPTION #4

FIG. 7
A-10798



WIRING
OPTION 2 & 3

FIG. 8
A-10780

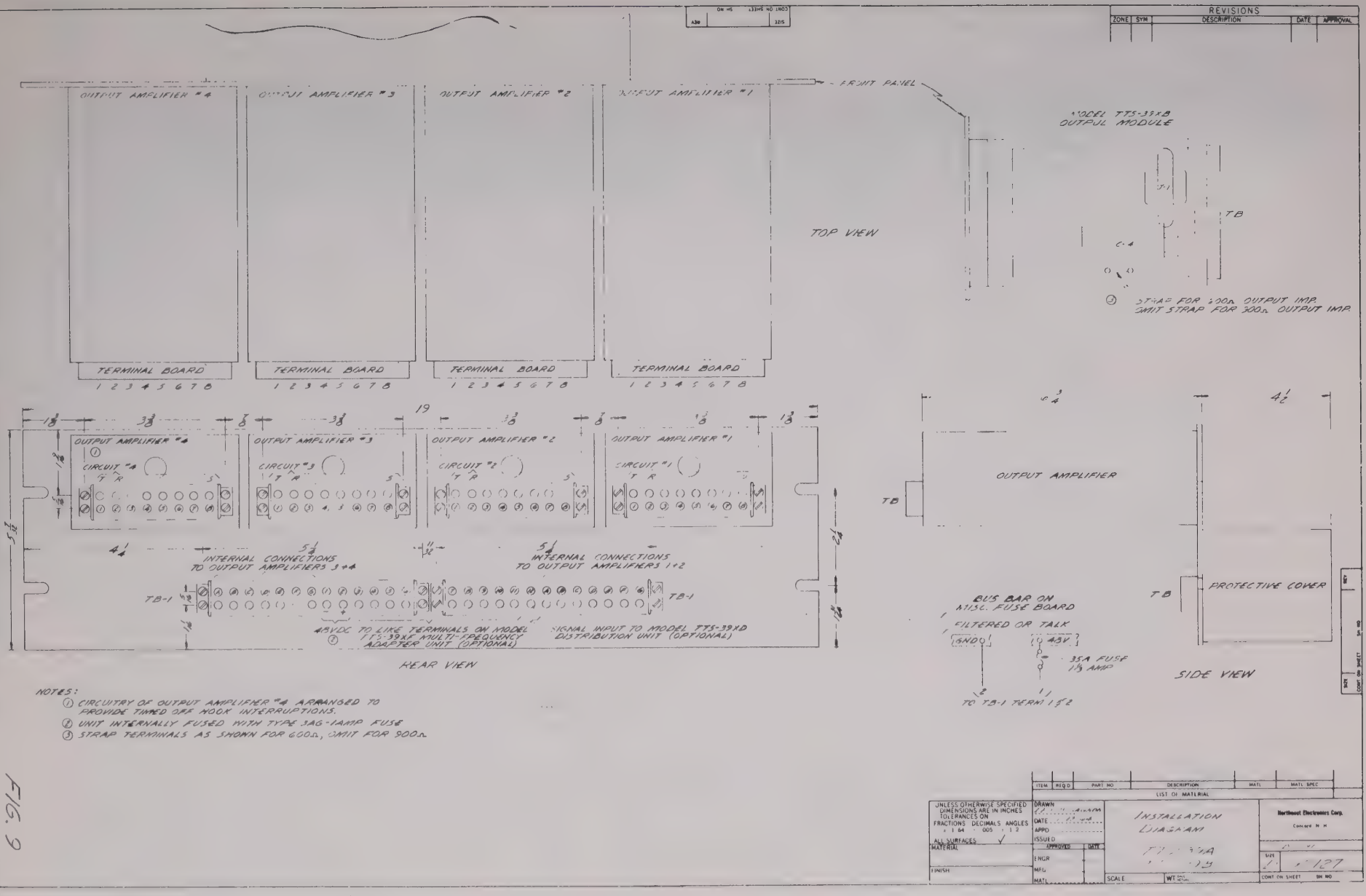
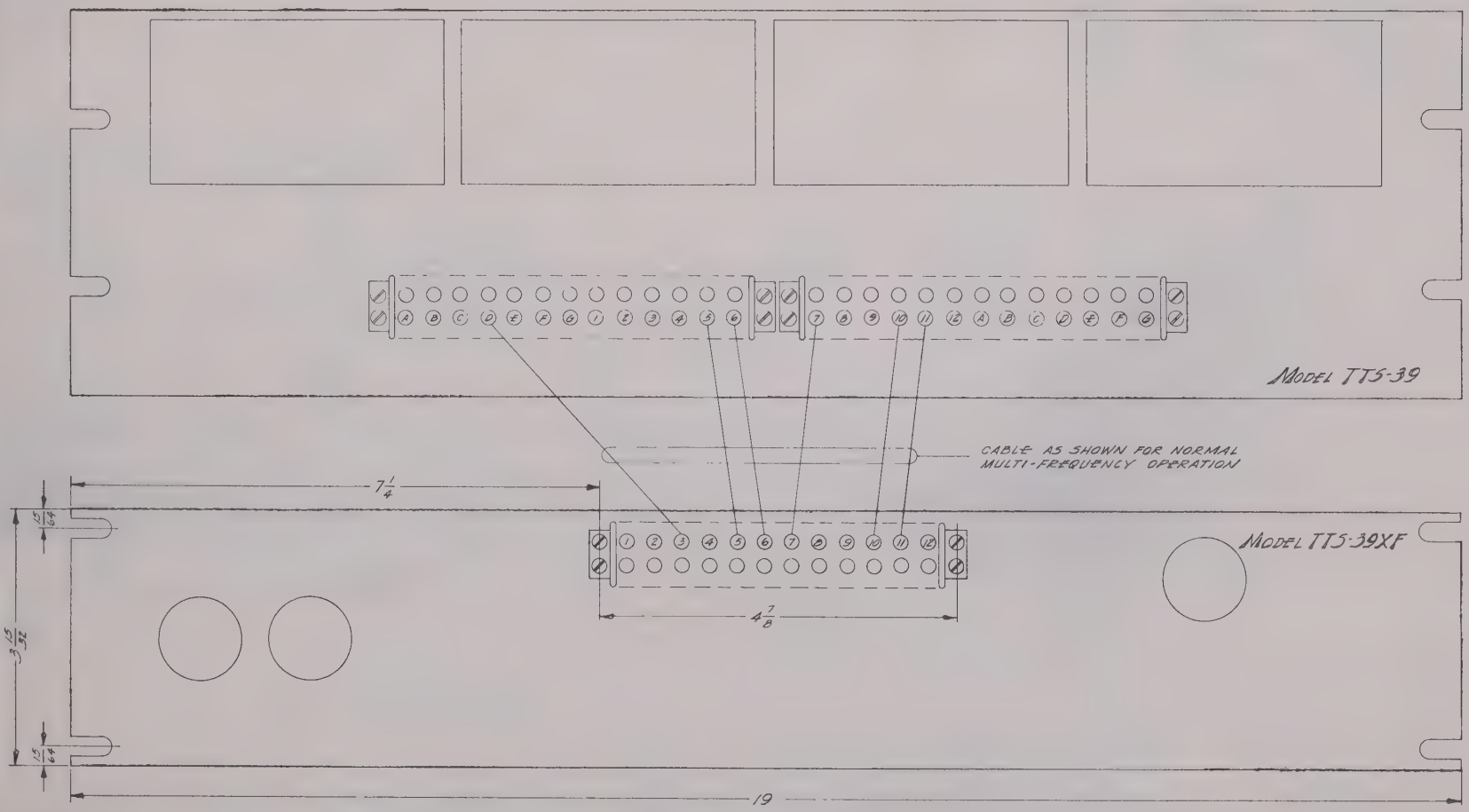
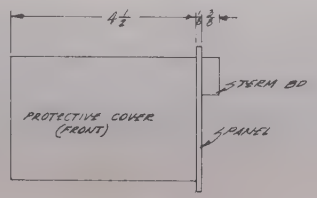

REVISIONS
ZONE SYM DESCRIPTION DATE APPROVAL
OUTPUT AMPLIFIER "4
OUTPUT AMPLIFIER "3
OUTPUT AMPLIFIER "2
OUTPUT AMPLIFIER "1
FRONT PANEL
TERMINAL BOARD
1 2 3 4 5 6 7 8
TOP VIEW
MODEL TTS-39XB
OUTPUT MODULE
TB
C-4
③ STRAP FOR 600Ω OUTPUT IMP.
OMIT STRAP FOR 900Ω OUTPUT IMP.
CIRCUIT "4
CIRCUIT "3
CIRCUIT "2
CIRCUIT "1
INTERNAL CONNECTIONS TO OUTPUT AMPLIFIERS 3+4
INTERNAL CONNECTIONS TO OUTPUT AMPLIFIERS 1+2
TB-1
48VDC TO LIKE TERMINALS ON MODEL TTS-39XE MULTI-FREQUENCY ADAPTER UNIT (OPTIONAL)
SIGNAL INPUT TO MODEL TTS-39XD DISTRIBUTION UNIT (OPTIONAL)
REAR VIEW
OUTPUT AMPLIFIER
PROTECTIVE COVER
SIDE VIEW
BUS BAR ON MISC. FUSE BOARD
FILTERED OR TALK
GND
48V
3.5A FUSE 1/8 AMP
TO TB-1 TERMI 1 & 2
NOTES:
① CIRCUITRY OF OUTPUT AMPLIFIER "4 ARRANGED TO PROVIDE TIMED DIP HOOK INTERRUPTIONS.
② UNIT INTERNALLY FUSED WITH TYPE 3AG-1AMP FUSE
③ STRAP TERMINALS AS SHOWN FOR 600Ω, OMIT FOR 900Ω
ITEM REQD PART NO DESCRIPTION MATL MATL SPEC
LIST OF MATERIAL
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS DECIMALS ANGLES
ALL SURFACES
MATERIAL
FINISH
DRAWN
DATE
APPD
ISSUED
APPROVED DATE
ENGR
MFG
MATL
INSTALLATION DIAGRAM
Northeast Electronics Corp.
SCALE
WT
SIZE
CONT ON SHEET DR NO

FIG. 9

REVISIONS				SIZE	REV
				CONT ON SHEET	SH NO
ZONE	SYM	DESCRIPTION		DATE	APPROVAL



- REAR VIEW -



- SIDE VIEW -
(N.T.S.)

FIG. 10

ITEM	REQ'D	PART NO	DESCRIPTION	MATL	MATL SPEC
			LIST OF MATERIAL		

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES ± ½°
ALL SURFACES ✓
MATERIAL
FINISH
PAINT
SCREEN PER

DRAWN J.C. JOHNSON
DATE JUNE 17, 1964
APPD
ISSUED

	APPROVED	DATE
ENGR		
MFG		
MATL		

INTERCONNECTION DIAGRAM
MODEL TTS-39XF
ADAPTED TO TTS-39A/B GEN

SCALE FULL WT CALC ACTUAL

NORTHEAST ELECTRONICS CORP.
CONCORD, N. H.
REF NO. C-1191
SIZE C 60637
CONT ON SHEET SH NO

REV
SH NO
CONT ON SHEET
SIZE

TABLE OF REPLACEABLE PARTS

Circuit Ref	Description	Mfr* & Mfr's Designation
	Model TTS 39 Basic Panel Components	
R31	Resistor: fixed, wirewound, 100 ohms ±5%, 5 w	P, 243E1015
R32	Resistor: fixed, wirewound, 1.2 K ±10%, 3 w	M, PW-3
R34	Resistor: fixed, wirewound, 600 ohms ±10%, 3 w	M, PW-3
R35	Resistor: fixed, composition, 100 ohms ±10%, ½ w	B
C1	Capacitor: fixed, disc, .01 mfd, 600 vdc	F, 1D-.01
C2	Capacitor: fixed, electrolytic, 100 mfd, 50 vdc	P, TVA 1310
C3	Capacitor: fixed, electrolytic, 100 mfd, 50 vdc	P, TVA 1310
C4	Capacitor: fixed, electrolytic, 20 mfd, 25 vdc	L, APD-046
CR1	Diode: silicon	R, 1N2069
Tx	Thermistor	V, 32A3
	Oven, 24V-55° Thermistor Unit	N, NE-62
S1	On-Off Switch: SPST	A, 20994-LH
PL1	Pilot Light Assembly	I, 105-4428-722
	Lamp: 48-volt	I, 55C
F1	Fuse Holder	E, HKP
	Fuse: 1 amp	W, 3AG-1A
TB1	2 13-position strips	G, 13-140
J1	Oscillator Test Jack	Q, L-12B
	Model TTS 39A&B Oscillator Board	
R14	Resistor: fixed, composition, 47 K ±10%, ½ w	B
R15	Resistor: variable, 400 ohms	H, CM22425
R16	Resistor: fixed, composition, 220 ohms ±10%, ½ w	B
R17	Resistor: fixed, composition, 3.3 K ±10%, ½ w	B
R18	Resistor: fixed, composition, 220 ohms ±10%, ½ w	B
R19	Resistor: variable, 400 ohms	H, CM22425
R20	Resistor: fixed, composition, 1 K ±10%, ½ w	B
R21	Resistor: fixed, 100 K ±10%, ½ w	B
R22	Resistor: fixed, composition, 100 K ±10%, ½ w	B
R23	Resistor: fixed, composition, 10 K ±10%, ½ w	B
R24	Resistor: fixed, composition, 27 K ±10%, ½ w	B
R25	Resistor: fixed, composition, 300 K, ±5%, ½ w	B
R26	Resistor: fixed, composition, 750 ohms ±5%, ½ w	B
R27	Resistor: fixed, composition, 10 K ±10%, ½ w	B
R28	Resistor: fixed, composition, 6.2 K ±5%, ½ w	B
R29	Resistor: fixed, composition, 1.5 K ±5%, 1 w	B
R30	Resistor: fixed, composition, 620 ohms ±5%, ½ w	B
R33	Resistor: fixed, composition, 1 K ±10%, 1 w	B
R89	Lamp: tungsten, 4 w, 120 v	K, T4-½
R90	Resistor: fixed, composition, 10 K ±10%, ½ w	B
C1	Capacitor: fixed, electrolytic, 20 mfd, 25 vdc	L, APD-046
C2	Capacitor: fixed, electrolytic, 20 mfd, 25 vdc	L, APD-046
C3	Capacitor: fixed, electrolytic, 20 mfd, 25 vdc	L, APD-046
C4	Capacitor: fixed, paper, .0096 mfd, 100 vdc	P, 194P96251
C5	Capacitor: fixed, paper, .0096 mfd, 100 vdc	P, 194P96251
C6	Capacitor: fixed, electrolytic, 20 mfd, 25 vdc	L, APD-046
C7	Capacitor: fixed, electrolytic, 20 mfd, 50 vdc	P, TE 1305
C9	Capacitor: fixed, electrolytic, 100 mfd, 50 vdc	L, APD-127

TABLE OF REPLACEABLE PARTS

Circuit Ref	Description	Mfr* & Mfr's Designation
	Model TTS 39A&B Oscillator Board, Cont'd	
Q1-Q5	Transistors	S, 2N1375
Q6	Power Transistor	D, 2N1136A
	Printed Circuit Board: (OSC)	J, E95026
	Model TTS 39A&B Output Modules, Model B	
R1	Resistor: selected value	
R2	Resistor: fixed, composition, 220 K ±10%, ½ w	B
R3	Resistor: variable, 5 K	H, CM29064NP
R4	Resistor: fixed, composition, 4.7 K ±5%, ½ w	B
R5	Resistor: fixed, composition, 10 K ±5%, ½ w	B
R6	Resistor: fixed, composition, 4.7 K ±5%, ½ w	B
R7	Resistor: fixed, composition, 470 K ±10%, ½ w	B
R8	Resistor: fixed, composition, 820 ohms ±5%, ½ w	B
R9	Resistor: fixed, composition, 10 K ±5%, ½ w	B
R10	Resistor: fixed, composition, 2.2 K ±5%, ½ w	B
R11	Resistor: fixed, composition, 10 K ±5%, ½ w	B
R12	Resistor: fixed, composition, 493 ohms ±1%, ½ w	M, CEC-TO
R13	Resistor: fixed, composition, 307 ohms ±1%, ½ w	M, CEC-TO
R14	Resistor: fixed, wirewound, 1.2 K ±10%, 3 w	M, PW-3
R15	Resistor: fixed, wirewound, 900 ohms ±10%, 3 w	M, PW-3
R16	Resistor: fixed, wirewound, 1.2 K ±10%, 3 w	M, PW-3
R17	Resistor: variable, 5 K	H, CM29064NP
R17A	Resistor: fixed, composition, 2.2 K ±5%, ½ w	B
C1	Capacitor: fixed, electrolytic, 20 mfd, 25 vdc	L, APD-046
C2	Capacitor: fixed, electrolytic, 5 mfd, 50 vdc	P, TVA 1303
C3	Capacitor: fixed, electrolytic, 20 mfd, 25 vdc	L, APD-046
C4	Capacitor: fixed, electrolytic, 50 mfd, 75 vdc	P, D27359
C5	Capacitor: fixed, electrolytic, 100 mfd, 50 vdc	L, APD-127
C6	Capacitor: fixed, disc, .001 mfd, 600 vdc	P, 5GA-D10
CR1	Diode	R, 1N38BS
CR2	Diode	R, 1N38BS
Q1-Q3	Transistors	S, 2N1375
T1	Transformer: Line to Line	T, S-58X
J1	Output Jack	Q, 54-SF
TB1	Terminal Strip	G, 8-140 3/4w
	Printed Circuit Board	J, E-95023
	Model TTS 39B Time Cycle Generator	
R1	Resistor: fixed, composition, 5.1 K ±5%, ½ w	B
R2	Resistor: fixed, composition, 1.8 K ±5%, 1 w	B
R3	Resistor: fixed, composition, 1.2 K ±10%, 1 w	B
R4	Resistor: fixed, composition, 2.2 K ±5%, ½ w	B
R5	Resistor: selected value	
R6	Resistor: selected value	

TABLE OF REPLACEABLE PARTS

Circuit Ref	Description	Mfr* & Mfr's Designation
	Model TTS 39B Time Cycle Generator, Cont'd	
C1	Capacitor: fixed, electrolytic, 100 mfd, 20 vdc	L, APD-095
CR1	Diode: silicon	R, 1N2069
CR2	Diode: regulator, silicon	U, 1N769
Q1	Transistor	S, 2N1375
K1	Relay: 2500 ohm coil	O, RS5D
K2	Relay: 2500 ohm coil	O, RS5D
	Model TTS 39XF Frequency Cycling Adapter	
R1	Resistor: fixed, composition, 12 K ±10%, ½ w	B
R2	Resistor: fixed, wirewound, 1.2 K ±10%, 3 w	M, PW-3
R3	Resistor: selected value	
C1	Capacitor: selected value	
C1-A	Capacitor: selected value	
C1-B	Capacitor: selected value	
CR1	Diode: silicon	R, 1N2069
CR2	Diode: silicon	R, 1N2069
CR3	Diode: silicon	R, 1N2069
CR4	Diode: silicon	R, 1N2069
D	Relay	X, 4R
DF	Relay	X, 42RO
SH	Relay	X, 42RO
S1	Stepping Switch	C, PW-56778-1
PL1	Pilot Light Assembly	I, 105-4428-722
	Lamp: 48-volt	I, 60-A
Hi-Z	Resistor: selected value	
Lo-Z	Resistor: selected value	
TB1	Terminal Strip	G, 12-140 3/4w
	Model TTS 39D Distribution Amplifier Panel	
R1	Resistor: fixed, wirewound, 1 K ±10%, 3 w	M, PW-3
R2	Resistor: fixed, wirewound, 1.2 K ±10%, 3 w	M, PW-3
R3	Resistor: fixed, composition, 100 K ±10%, ½ w	B
R5	Resistor: fixed, composition, 4.7 K ±10%, ½ w	B
C1	Capacitor: fixed, electrolytic, 100 mfd, 50 vdc	P, TVA 1310
C2	Capacitor: fixed, electrolytic, 20 mfd, 25 vdc	L, APD-046
C3	Capacitor: fixed, electrolytic, 20 mfd, 25 vdc	L, APD-046
Q1	Transistor:	S, 2N1374
CR1	Diode: silicon	R, 1N2069
F1	Fuse Holder	E, HKP
	Fuse: 1 amp	W, 3AG-1A
PL1	Pilot Light Assembly	I, 105-4428-722
	Lamp: 48-volt	I, 60-A
S1	On-Off Switch: SPST	A, 81015-BP
TB1	Terminal Strip	G, 21-104 3/4w
J1	Input Jack	Q, L-12B
J2	Buffer Output Jack	Q, L-12B

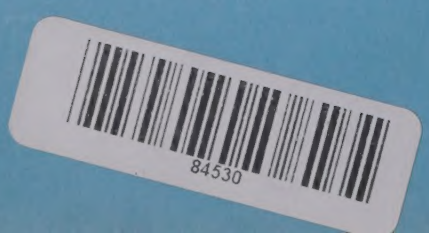
TABLE OF REPLACEABLE PARTS

Circuit Ref	Description	Mfr* & Mfr's Designation
	Model TTS 39D Distribution Amplifier Panel Output Modules 1,2,3, and 4 Model B	
R1	Resistor: selected value	
R2	Resistor: fixed, composition, 220 K ±10%, ½ w	B
R3	Resistor: variable, 5 K	H, CM29064NP
R4	Resistor: fixed, composition, 4.7 K ±10%, ½ w	B
R5	Resistor: fixed, composition, 10 K ±10%, ½ w	B
R6	Resistor: fixed, composition, 4.7 K ±10%, ½ w	B
R7	Resistor: fixed, composition, 470 K ±10%, ½ w	B
R8	Resistor: fixed, composition, 820 ohms ±10%, ½ w	B
R9	Resistor: fixed, composition, 10 K ±10%, ½ w	B
R10	Resistor: fixed, composition, 2.2 K -10%, ½ w	B
R11	Resistor: fixed, composition, 10 K ±10%, ½ w	B
R12	Resistor: fixed, composition, 493 Ohms ±1%, ½ w	M, CEC-TO
R13	Resistor: fixed, composition, 307 ohms ±1%, ½ w	M, CEC-TO
R14	Resistor: fixed, wirewound, 1.2 K ±10%, 3 w	M, PW-3
R15	Resistor: fixed, wirewound, 900 ohms ±10%, 3 w	M, PW-3
R16	Resistor: fixed, wirewound, 1.2 K ±10%, 3 w	M, PW-3
R17	Resistor: variable, 5 K	H, CM29064NP
R17A	Resistor: fixed, composition, 2.2 K ±5%, ½ w	B
C1	Capacitor: fixed, electrolytic, 20 mfd, 25 vdc	L, APD-046
C2	Capacitor: fixed, electrolytic, 5 mfd, 50 vdc	P, TVA 1303
C3	Capacitor: fixed, electrolytic, 20 mfd, 25 vdc	L, APD-046
C4	Capacitor: fixed, electrolytic, 50 mfd, 75 vdc	P, D27359
C5	Capacitor: fixed, electrolytic, 100 mfd, 50 vdc	L, APD-127
C6	Capacitor: fixed, disc, .001 mfd, 600 vdc	P, 5GA-D10
CR1	Diode	R, 1N38BS
CR2	Diode	R, 1N38BS
Q1-Q3	Transistors	S, 2N1375
T1	Transformer: Line to Line	T, S-58X
J1	Output Jack	Q, 54-SF
TB1	Terminal Strip	G, 8-140 3/4w
	PrintedCircuit Board	J, E-95023

*See List of Manufacturers Code Letters for Replaceable Parts Table

LIST OF MANUFACTURERS CODE LETTERS FOR REPLACEABLE PARTS TABLE

Code Letter	Manufacturer
A	Arrow-Hart, and Hegeman Electric Company
B	Allen Bradley Company
C	Automatic Electric Company
D	Bendix Aviation Corporation
E	Bussman Manufacturing Company
F	Centralab
G	Cinch Jones Manufacturing Company
H	Clarostat Manufacturing Company, Inc.
I	Dialight Corporation
J	Defiance Printed Circuit Corporation
K	Herzog Miniature Lamp Works, Inc.
L	International Electronic Industries
M	IRC, Inc.
N	Northern Engineering Labs, Inc.
O	Potter and Brumfield
P	Sprague Electric Company
Q	Switchcraft, Inc.
R	Sylvania Electric Products, Inc.
S	Texas Instruments, Inc.
T	Triad Transformer Corporation
U	Transitron Electronics Corporation
V	Victory Engineering Corporation
W	Littelfuse, Inc.
X	Sigma Instruments, Inc.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